TWENTY-FIRST YEAR OF PUBLICATION.

THE

JOURNAL OF SCIENCE,

AND ANNALS OF

ASTRONOMY, BIOLOGY, GEOLOGY, INDUSTRIAL ARTS, MANUFACTURES, AND TECHNOLOGY.

(MONTHLY, FORMERLY "THE QUARTERLY JOURNAL OF SCIENCE.")

ROYAL MICROSCOPICAL SOCIETY

Vol. VI. (THIRD SERIES)
No. CXXXI.

NOVEMBER
1884.

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LONDON:

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THE

JOURNAL OF SCIENCE.

NOVEMBER, 1884.

I. THE WAY TO THE POLE, AND SOME OBSERVATIONS OF THE GREELEY EXPEDITION.

By the Count O. REICHENBACH.

WHEN, in the January number of the "Journal of Science" for 1884, I showed that by theory I had anticipated what Baron Nordenskjœld found and misinterpreted, and when the observations of the Greeley Expedition again confirm my theories, my view about the way to the Pole deserves examination when new expeditions are projected.

In March, 1869, the following letter was addressed to the "Cologne Gazette," but not published "because it might interfere with the sending of Captain Koldeway's Expedition." A needless fear; for it would have as little altered the mind of its promoters as its communication induced the leaders of the Austrian Expedition to try that route "whose first stage" "is the mouth of the Lena," "which Professor Nordenskjœld hopes to reach this year on his way to Behring Strait."

"To the Editor of the 'Cologne Gazette.'

"You favour the Expedition promoted by Dr. Petermann. He says the stream which runs along the coast of Greenland comes from the Obi and Lena. Being right, he strangely sends his ships against, not with, the ice driving.

"The Pole is the ultimate aim. My view of the true way to reach it is based on a general theory of the configuration of the earth and of oceanic circulation. The ocean

divided by continents resembles lakes connected by streams and currents; their height and temperature change with seasons.

"The Arctic lake joins the others by three inlets. The current of the warm stream which chiefly feeds it comes from Central America, from the longitude of Pailon, through 90° north by east; it crosses the Arctic circle in the meridian tangent to West Africa under the Equator; its mean line of intensity is inclined 23° 28′ to the meridian.

"As the Central American waters are moved 7° 52′ north by Panama, and in a second wave 6° 52′+3° 52′=10° 44′ by South America, so they are moved through equal latitudes to Spitzbergen Bank and to Spitzbergen, and from the entrance of the White Sea to the north of Novaya Zemlya. The northward movement of the sun towards the end of December is accompanied and followed by an increasing, accelerated, warmer flood of the stream. The water rises in the Arctic lake through over three months, continues somewhat less time at about the same mean level, and then falls and stops through similar periods. The level within the lake itself and its outlets differs, and varies besides regionally.

"The waters leaving the Caribbean Sea at the end of December begin to arrive at the places named about the end of April and beginning of May; having travelled within the circle through an arc of 23° 28′+3° 52′, they reach and round Cape Tcheljuskin, projecting 10° 44′ north of the Arctic circle, before the summer solstice, gradually spread to Behring Strait, 46° 56′, the diameter of the polar circle, distant from the Maelstrom, their point of entrance in the circle and join the small current entering at high water through that strait from the Pacific Ocean.

"The great stream, in the mean inclined 23° 28′ to the meridian, tends back south by east after having run through the 90° to the Arctic circle. As its current is, however, moved 3° 52′ farther north by the Finnian North Cape, the stream still further corresponding to Panama and South America north of the Equator, the greatest tendency of return south by east only sets in towards the east of the White Sea. The warm stream, cooling down to the greatest density of sea water, sinks therefore only east of that sea below the colder water and ice of the lake all along East Russia and West Siberia. It first presses from the deep against the ice-bound coasts, then, filling the lake, lifts the ice. Later on, when the flood still rises, the ocean current resisted, turned back by the land, has to move north towards

the Pole; it is assisted by the rising warming rivers. It reappears at the surface of the inundation; the broken ice is driven from the Arctic coasts of the old continents, and lodges and packs in a semicircle from Spitzbergen east and north and north-west, heaving hither and thither on the boundary of the stream flowing in from the south, to the west and north of Europe towards the east, then straight north, and returning on itself back to the south at its own west, along East and West Greenland.

"At the end of June the lake is at high water, also at its east. The ice-driving, which commenced in the current after the solstice, lasts till about the Equinox, then comes to a stand-still with the falling water and increasing cold.

"The current, risen to the surface, starts at the end of June from both sides of the peninsula, flanked by the mouths of Obi and Lena, but principally from its east side from the Gulf of Chatanga. Its course is best shown by describing from the point of entrance into the Arctic circle 6° longitude west of Norway, as centre, with a radius of 23° 28′, an arc starting from the coast of Siberia (Jennissey) through the North Pole and back, and another such arc from the Finnian North Cape, with the same radius, starting from the Gulf of Chatanga, reaching 3° 52′ beyond the Pole. These arcs, starting from both sides of the North East Cape (Tcheljuskin) have the current between them until it divides between the Pole and 87° N. lat., to the north of Greenland, and flows out to both sides of the latter, meeting at its west the outlets of its own side waters and of the small stream entering through Behring Strait. The branch flowing out to the east of Greenland is separated from the side or still waters of the inflowing stream by a submerged ridge discernible by Iceland, Jan Mayen, &c. The whole eastern side of the current and stream from north of the Lena to beyond the Pole will be marked by small islands.

"When the inflowing stream rises rapidly with the spring Equinox it inundates the outflowing branch from south to north: on this depend the oscillations of the pack-ice. The opposite takes place at the opposite season. It is side water of the oceanic motion, south to north, which principally after the spring Equinox appears as counter current south to north, most ostensibly along the west coast of Greenland.

"The Arctic Archipelago and Greenland extend to 23° 28′+3° 52; north of Cape Farewell, in 59° 38′ N. lat., to 83° 6′ (small projections balanced by recessions representing inferior disturbances); but Greenland has at its

east, in about 20° W. long. Gr., a peninsular or long island extension reaching 3° 52′ farther north to 86° 58′, at its northern end, with a bend west, turning part of the return current to the east of Greenland. To the west of this mole, protecting Smith Sound, pack-ice periodically settles, and is cleared out again in years of particular high water (nutation).

"If a vessel coming from the West wintered in or to the north of the Gulf of Chatanga, and then followed the great current as soon as the real ice-driving begins its motion north, about the end of June, she might—keeping to the course described—perhaps navigate past the Pole and return along the east of Greenland, or, crossing the still water, arrive at Behring Strait, or get to Smith Sound; and if the vessel had there to be abandoned, the Expedition might possibly get back by land; the undertaking to be confined to the shortest time possible, and to be carried out by a combination of governments and private promoters taking an interest in a scheme whose scientific results hardly compensate the sacrifices incurred.

"The ice-driving will be in full swing round the Siberian peninsula at the end of June, but the larger mass of ice will only float off several weeks later (Von Middendorf found the mean temperature of the Bogonida, a small river of the Siberian peninsula, +10° 6′ (in August). Would it, then, be better to work on at once amidst the ice in June, or to lose the best time and wait till the end of July?

"The vessel keeping to the eastern side of the current, taking advantage of its theoretically presumable bend, ought rather to avoid than seek the bordering islands; for the object of Arctic adventures ought not to be the discovery of a few more patches of land, but the insight into the configuration and oceanic circulation of the Polar regions."

In the January number (1884) of the "Journal" may be found what I said in "On some Properties of the Earth" (1880) about the south and middle parts of Greenland and their interior; but also about the still unknown north-east and the north-west, and Grinnelland, about the Archipelago, and about the open sea of Dr. Kane; it is confirmed by Lieut. Greeley's reports.

And I shall have again to quote from "On some Properties" in speaking of Lieut. Greeley's continuous careful observation, for which he sees, however, no explanation, that the tides, which "at their most northern settlement flowed from the north," averaged 3° F. below freezing-point, equal

to −1·666° C., and was 2° F. warmer than at Cape Sabine, where the tide flowed from the south, and therefore averaged 5° F. below freezing-point, equal to −2·77° C.

The figure 1·666, and the temperature 1·666°, and its negative −1·666° occur so often in the volume named that I shall only quote passages bearing more immediately on the apparently anomalous phenomena observed.

Pages 10, 11.—"The direction of the Isorachis is determined not only by the size of the oceans and the width of the channels, but also by those streams with whose motion the influences of moon and sun combine." "In the Arctic sea the tide goes north where the stream enters, south where it leaves."

Page 97.—"The average temperature of an upper 1·41′ thick layer of the earth is 20° C.; the vapour leaves it at 20°: that of the equally thick sublayer is—

$$20° + 1·666° - 0·43°.$$"

Page 98.—"Ocean water has a greater capacity for heat than water; it requires a higher temperature to boil and a lower one to freeze; it changes its nature by evaporation and by freezing; it is diminished by the salts in the first case, and dismisses them in the other: these changes set in at 1·666° and −1·666° C.

Page 99.—"The ocean must have *an own temperature* of 1·666° C., and an upper layer of the land will also have an own temperature of 1·666°."

Page 177.—The Earth, as it is, is part of the Solar system. It has in its outside layer, to the depth of 15,180 feet, *an own temperature* of 1·666°, which is the product of its growth, and a temperature which is the product of the continuous action of solar gravity on the gravity of the Earth."

Page 209.—The mean temperature at the bottom of the sea is 1·666° C."

Page 113.—"Ocean water has qualities playing an important part in the distribution of temperature; it does not only yield, it also absorbs vapour, and prevents local excesses of heat, rain, and freezing; it maintains its circulation."

Page 194.—"The vapour absorbed by the sea being $8·87' \div 3·83 = 8·87' - 6·56' = 2·3'$ of water, the $1 \div 1713$ of the sweet sea (or 78·07 inches out of the 106·49″) return as rain, snow, hail, fog, dew, and hoar frost. The $2·31' = 27·7''$ absorbed by the sea, beyond 30° of latitude, and principally in the highest latitudes and polar regions, maintain its temperature in the midst of the winter at −1·666° in those

regions; the temperature becomes only locally lower when the returned sun begins to melt the ice, principally the drifting land ice."

Page 194.—"All vapour from the Earth gets divided into waves with ascending and descending branches. The greatest mass of vapour ascends from the tropics. As the decrease of temperature" (with height) "is there more rapid, and with it the decrease of maximum tension of vapour, precipitation as rainfall will also be greatest in the meteorological tropics. But a portion of the originally greatest mass of ascending vapour penetrates, by the relays of heat afforded by precipitation, to the heights of the atmosphere; thinner vapour waves, with greater radius and orbit, and increasing velocity of ascent in the rarefied air, overreach the smaller, more dense, and pass with their descending branches on to the highest latitudes to be absorbed by the sea as vapour; they bring cold in the air, which becomes heat in the sea."

Page 115.—In the highest latitudes, in the long nights of the Polar regions, and at times in subpolar climates, there is little or no evaporation, but only absorption of vapour warming the sea. Capt. Nares found in the Arctic regions the lowest temperature of the sea 'during winter' (not at the time of the greatest cold) '$-2{\cdot}08°$ C.,' for only when the warm season begins this temperature sinks below that of the air; this is $-0{\cdot}43°$ in excess of $-1{\cdot}666°$: he also found the water on several occasions at the surface lower in temperature than that of the underlying stratum, absorption having the like effect as evaporation,—not the salt but the water being now most warm and most dense, being below, yet nearer, the $+4{\cdot}1°$, than in the somewhat warmer climates. On one occasion the difference amounted to $0{\cdot}83°$, almost twice $0{\cdot}43°$. If these observations had been regular the average excess in the immediate substratum below about 1·14′ would have been $0{\cdot}43°$."

Page 116.—"Heat leaves the upper stratum in opposite directions; the sea decomposes the $1{\cdot}666°$ between sea and salt, turning $0{\cdot}435°$ into vapour ascending into the atmosphere, and $1{\cdot}231°$ into brine, which sinks by increased specific weight." This is true for the Polar regions with the negative sign; the $-2{\cdot}77°$ of the tide at Cape Sabine were close to $-1{\cdot}666°+(-1{\cdot}231°)$.

Page 127.—"The reason for this high temperature" (the $-1{\cdot}666°$) "is, sea-water of normal saltness below $1{\cdot}666°$, and under pressure of one *air* atmosphere, does not attract, but absorbs, vapour. It is not the water but the salt which attracts the vapour.

Page 128.—"The attractive and repulsive, heating and lighting effects of the Sun and the Earth vary. The $1 \div 29{\cdot}78$ of salts balances the inequality of action, within sea, atmosphere, and land. When the Sun draws nearer and farther, evaporation and the distribution of temperature vary in water and air, and the displacement of weight and water is balanced by weights of salts moved in opposite directions. This will be true *for the tides* solar and lunar: I do not speak of the Moon; it would make complication more complicated. Large masses of water cannot be raised and dropped without the distribution of their temperature and of the salts they contain being affected. The continents heated by the Sun, overspread by the atmosphere, pressed and shaken by the sea, and acted upon by the consequent frictional heat engendered in elastic matter between shell and nucleus, must participate in all oscillations."

Page 127.—"It is not the greatest cold, but the going cold, the ice of the land and the icebergs melting, what makes the sea coldest. The mean temperature of the upper $1{\cdot}14'$ layer of the open sea, or the sea below the ice, is $-1{\cdot}666°$ C."

The wide surface of the Arctic lake through which the stream and current circulate most attracts the descending warming vapour. The stream flows out to both sides of Greenland. At the west, far more still than at the east side, it is confined within straits and channels, encountered, dammed up, and repressed by the greater mass of water moving past from south to north along America towards Europe; it so sinks as current below the inundating waters, increased by the saltless waters from on land, and increased and deprived of heat by the masses of melting ocean and land ice; deprived of power of attraction for the descending vapour, which becomes to a great extent deposited as ice on land, diminishing the proportion of decrease of temperature with height in the overlaying air. The outflowing stream so has its tide from the north, the inflowing inundation water has it from the south.

At the most northern settlement the only outflowing stream, with the tide in the direction of its motion, had at surface the normal Polar ocean temperature $-1{\cdot}666°$, and the height of the tide reached in Franklin Bay 8 feet; at Cape Sabine the temperature of the tide of the spurious stream from the south was $-2{\cdot}77°$, and the height of the tide reached 12 feet: $-1{\cdot}666°$ being to $-2{\cdot}77°$ as $8'$ to $12'$, the heights of the tides were, singularly enough, as the temperatures below freezing-point, and both as $1 : 1{\cdot}666$,—a curious coincidence.

At some point farther south the temperature would have shown the full $-1{\cdot}666° + (-1{\cdot}235°) = -2{\cdot}897°$. And there must be between the two stations of observations a line oscillating with seasons and years, where the two tides from north and south meet, the higher one overlapping, and the former passing with a temperature $-1{\cdot}666°$ below the other with a maximum cold of $-2{\cdot}897°$.

This will produce north of the line of meeting by the mixing of the waters, by the thinning out of the southern and the thickening of the northern tide, by the more eager absorption of vapours by the more salted northern waters (salt being precipitated from the upper colder layer), by the motions of the different salts (with regard to which I must refer to the volume quoted), by the friction and contact of the two tides, we may say the $-1{\cdot}666° + (-0{\cdot}435) = 2{\cdot}08°$ in the upper layer and the $-1{\cdot}666° - (-0{\cdot}435°)$ in the sublayer, observed once as an extreme case of the rule of temperature between the two layers by Captain Nares (see quotations from page 116 and page 115, as before).

II. FIREBALL RADIANT IN SEXTANS.

By W. F. Denning, F.R.A.S.

THERE is a prominent meteor shower from the N.W. limit of the small constellation Sextans (Hevelius), the place of the astronomical radiant point being at about α 145° δ +6°, which is some 8° S.W. of α Leonis and 15° N.N.E. of α Hydræ. The display is a remarkable one for two reasons,—namely, its apparent persistency, and for the immense fireballs which it occasionally yields from about the end of January to the middle of March, and probably later.

On February 13th, 1871, 9 h. 4 m., I observed a large fireball which in point of size and brilliancy rivalled the full moon. It traversed the southern part of Orion, disappearing at $62\frac{1}{2}° - 15°$, where it projected a vivid streak for ten minutes. This meteor was also seen at Rugby, where the recorded path was very similar to that descried at

Bristol; it was likewise noticed at many other places, including Exeter, Torquay, and Callington in Cornwall.* The radiant point from a comparison of the observed flights is north of *α* Hydræ. Mr. W. H. Wood described it as "near *α* Hydræ," from his discussion of the observations.

On February 2nd, 1876, 8 h. 31 m., I saw a small bolide, equal to Mars, threading its way slowly along a short arc amid the stars of Coma Berenices. Path from 175°+31° to 185°+35°. On February 4th, of the same year, at 7 h. 35 m., I recorded a slow-moving fireball emitting a light about ½=☽. It traversed a course of 24° between Taurus and Eridanus. This meteor considerably exceeded the small bolide of February 2nd as regards magnitude and visible effect, but otherwise their features nearly coincided, and the relative directions exhibit a radiant near the star *α* Leonis as their point of mutual intersection.

On March 17th, 1877, 9 h. 54 m. a large fireball, estimated ½=☽, was observed at Bristol as it travelled slowly through Monoceros. The same meteor was seen and described from many other parts of the kingdom. Col. Tupman computed the orbit, and found the apparent radiant at about 145°—4°.†

On January 27th, 1879, 14 h. 28 m., an immense fireball, with a diameter said to exceed 2° (4×☽), and casting off a perfect ring of fiery sparks, was seen in America. It "produced a violent explosion like an earthquake's shock, in Traverse City, Michigan," and moved slowly from a radiant at about 142°+14°, according to the combined observations at Wisconsin and Michigan.‡

On February 21st, 1879, 12 h. 20 m., a vivid fireball, with a nucleus half the moon's apparent diameter, was seen in Essex, Suffolk, and Cambridgeshire. It "burst into fragments with a report like thunder, heard in less than half a minute at Haverhill and at Saffron Walden in Essex." The radiant point was at 140°+5° (±7°), near the head of Hydra.§

It is to some extent questionable whether these fireballs were severally evolved from the same parent stream, but the fact is a suggestive one that the relative directions are so closely conformable to one centre, that, allowing for the probable errors of observation affecting the individual instances, a common derivative radiant may justly be attributed them. In any case it may be regarded as proved that here, in the special region included between the stars *α* Leonis and *α* Hydræ, there is a well-defined and singularly persistent radiant of fireballs, some of which are detonating and of

* British Association Report on Luminous Meteors, 1871, p. 33.
† Monthly Notices, vol. xxxvii., p. 353; and Observatory, vol. i., pp. 19, 20.
‡ Monthly Notices, vol. xl., p. 257. § *Ibid.*

very great magnitude. The display is obviously of such striking character as to render it eminently suited for future investigation. The brilliant and startling aspect of its more conspicuous meteors, the seeming endurance of the shower far beyond ordinary limits, and its very favourable position in the winter sky, will doubtless cause it to attract many further observations. Showers of shooting stars of the normal type very probably issue from this radiant of fireballs, and it may be assumed, from the conclusive evidence afforded by other such streams, that they are not only concurrent in date, but closely associated in their physical origin. Whether the earlier meteoric displays which occur from the same region during the months of November and December have any distant connection with those operating in February, March, and early in April, is entirely a matter of conjecture in the present state of our knowledge. If we accept the theory of correlation between the successive groups of shower-meteors projected from this point of the sky during the winter months, we have an instance of the visible sustenance of a stream which far exceeds what is regarded as possible, so that pending renewed observations it will be safest to admit the extremely doubtful nature of the case. Though these recurrent showers from Sextans furnish a well-defined and apparently continuous radiant during the winter months, they may really consist of a succession of interwoven meteor groups whose peculiar arrangement has originally been due to the cumulative effects of perturbation exercised by the earth in her annual passages through the primitive stream.*

The series of radiants which have been previously determined are concentrated round the point 145·4°+3·9° as follows:—

No.	Epoch.	Radiant. α	Radiant. δ	Observations.
1.	1872, Oct. 29—Nov. 13	147°	+ 2°	†D. (from Ital. Obs.), 6 meteors.
2.	1876, Nov. 25—Dec. 21	148	+ 2	D., No. 46, 1876, 11 meteors.
3.	1877, December 8 ..	145	+ 7	D., No. 153, 1877.
4.	1870, January 4	142	+ 5	Tupman, No. 3.
5.	1880, January 7	140	+ 7	Sawyer, No. 1, 2nd catalogue.
6.	1877, January 9—17 ..	146	+ 4	D., very slightly observed.
7.	1870, January 11 ..	149	+ 5	Tupman, No. 3.
8.	1850-67, Jan. 3—Mar. 16	143	− 7	Greg and Herschel, No. 15.
9.	1872, Feb. 1—Mar. 12	147	+ 4	D. (from Ital. Obs.), 17 meteors.
10.	1878, Feb. 24—26 ..	145	+ 8	Sawyer, No. 3, 1st catalogue.
11.	1872, Mar 31—Apr. 12	147	+ 1	D. (from Ital Obs.), 7 meteors.
12.	1872, April 3	146	+ 9	Zona (stationary meteor).

Mean position from 12 observations = 145·4°+3·9°.

* See a condensed summary of Sig. Schiaparelli's views on the probable cause of diffuse and multiple radiants, and on the occurrence of families or groups of radiant points, in the British Association Report on Luminous Meteors for 1871, pp. 44 to 48.

† Refers to positions determined by the writer,

I believe the centre of the shower thus derived is very accurate in right ascension, but the declination is too far south. On December 8th, 1877, I witnessed this stream in special activity, and the point of radiation determined on that occasion was regarded as very sharply defined. This taken in conjunction with the pairs of positions by Col. Tupman and Mr. Sawyer (both of whom conducted and reduced their observations with considerable precision) indicate the radiant in $\delta = 6°{\cdot}4$, so that the place assigned from the twelve values is probably $2°{\cdot}5$ south of its true centre, owing in some measure to the very erratic, southerly position of No. 8. Let us compare the average radiant of the three great fireballs of 1877 and 1879 with that resulting from the above summary:—

		α	δ
Fireballs of 1877 and 1879	...	$142°{\cdot}3$	$+5°{\cdot}0$
Meteor showers, 1857—80	...	$145°{\cdot}4$	$+3°{\cdot}9$

The mean places of the radiant are therefore separated by little more than 3°. But the very grave doubts existing as to whether the whole series of showers is connected in sufficient degree to warrant their being thus incorporated and averaged must greatly detract from the significance of the accordance in the resulting positions. There are probably several distinct systems of meteors proceeding from nearly the same foci in Sextans during the months November to April, but their individual durations and epochs of maximum display cannot be attributed owing to the meagre character of the observations on which they are founded. It will be an essential part of future investigation to ascertain whether there is a continuous run of meteors from *exactly the same centre* in this region during the months from November to March. The fact is affirmed by the most reliable observations hitherto obtained, and it is singular that Sig. Zona, at Caltanisetta in Italy, observed a stationary meteor at 146°+9°, on April 3rd, 1872, and close to the point 145°+8°, where Mr. Sawyer, at Cambridgport, Mass., obtained a similar observation on February 24th, 1878, and where, on December 8th, 1877, I had determined the exact centre of a well-defined meteor shower.

In November and December the meteors discharged from this point are of identical type to the Leonids of November 12th to 14th; they are rather bright, moving very swiftly and uniformly leaving streaks, whereas the conformable meteors seen in the months of February and March are slow-moving, and it would seem of comparatively greater

magnitude. The former difference is the natural outcome of the change in the astronomical conditions affecting the apparent motions of the meteor particles relatively to that of the earth at the two epochs. Thus in November, when the radiant is near the earth's apex, the velocity of the particles at impact is near the maximum (about 44 miles per second), inasmuch as they fully confront the earth, and there is a direct *rencontre* at that time. The orbital motions of the earth (18·5 miles per second) and meteors (26 miles per second) are therefore combined in the observed effects. But early in February the circumstances are very different, the relative directions being nearly at right angles; hence the apparent velocity of the meteors accords with their real or native velocity. Later on this becomes further reduced, until the radiant point being near the earth's anti-apex, and the paths of the meteors and the earth being parallel in the same direction, the apparent meteor speed reaches a minimum of some 11 miles a second. Even during short periods great changes are effected in the conditions under which meteor showers are presented to our observation, and they are of such character as to suggest the utter inconsistency of individual streams having very long durations and fixed radiant points. But the fact of these consecutive showers from the same derivative point in Sextans is so well attested, and the same peculiarity so clearly demonstrated in regard to many other systems, that (though we may admit the difficulties attending its explanation) the subject should not be lost sight of by those who would form a right conception as to the phenomena of meteors. Anomalies of the character referred to may tend to induce further investigation, and lead us to modify our views as to the visible behaviour of certain streams which may show a width and construction of orbit entirely opposed to such well-defined though fugitive displays as the Quadrantids, Lyrids, Andromedes, and Leonids, which constitute groups of very special character, and cannot be regarded as typical of the multitude of more attenuated and apparently long-enduring showers with which the heavens so numerously abound.

It is worthy of note that this well-defined radiant point in Sextans does not appear in the catalogue of Sig. Schiaparelli's reductions of Zezioli's meteors of 1867-70, which contains a very large number of observations for the earlier months of the year. The shower was not quiescent at that time, as we know from Col. Tupman's records, which were of contemporary date. There is also no mention of this position in either of the extensive catalogues of Heis and

Schmidt; but very few paths were accumulated by these observers in January and February, and hence the radiant might easily evade discovery.

The fact that the finest meteors from this stream have been recorded during the displays occurring in the interval from the end of January to about the middle of March does not necessarily prove that the radiant point is more rich in fire-balls at that time than at an earlier period of its manifestation. The position of the shower must render it invisible until near midnight in November, while in January, February, and March it will be above the horizon nearly all night, and its favourable aspect in the evening sky enables it to command a large number of observers for its most striking meteors. In November such a shower would obviously escape the notice of all but those who extend their watches into the morning hours. I mention these circumstances to show that the foremost showers from Sextans may probably have greater strength than the observations indicate, though it has never been satisfactorily gauged.

A display which I saw during the two hours after midnight, on December 8th, 1877, was judged to be one of considerable importance. But from the perfect labyrinth of streams abounding in almost inextricable confusion of arrangement along the Earth's path, and in view of the difficulties inseparable from trustworthy determinations of intensity and epoch of individual systems, we may well be content for the present to point out such instances as deserve, as they will doubtless receive, further recognition at the hands of those observers who may hereafter apply themselves to investigations of this kind.

Bristol, 1884.

III. MORAL EPIDEMICS AND CONTAGIONS.

(Concluded from page 576.)

ON the contrary, do we wish to struggle against sadness? Then joyful countenances, brisk conversation, and gay songs will aid us in escaping from that state, just as in the above-cited example sound-waves assist us in

moving. Hence they please us, and easily become contagious.

Meanwhile, though at the first outset we may feel an extreme repugnance at feeling ourselves invaded—so to speak—by an expressive movement against which we are contending, yet on frequent recurrence this repugnance diminishes and disappears, when of course we give way to the external impulse. This has been already amply demonstrated.

If movements expressive of improper or criminal actions are communicated to the brain of persons present, those who are inclined to such actions will feel satisfied and will be easily carried away, whilst indifferent spectators will be more or less shaken. Good men will be wearied and revolted by the movement which seeks to invade them. Evidently such persons will not readily receive the contagion. Still in the long run, as in all other cases, these persons will more or less submit to the influence if they are not upon their guard.

These facts, if well understood and carefully analysed, yield a signal confirmation of M. Rambosson's law. We see very distinctly two movements contending in opposite directions; the movement coming from a foreign brain seeking to invade every brain which it can reach, to determine a reflex contagious action and to impose itself upon the *ego*, and, on the other hand, the *ego* which resists by an opposite action.

In a word, we easily see why some given expression may please and soothe us at one moment and displease and weary us at another; why it may be useful under certain circumstances and harmful under others, and why it may in different cases be more or less contagious.

These considerations will go far to explain not a few moral and social phenomena. We can now understand the influences—good or evil—of example and companionship, and see tangible reasons for avoiding scenes where our principles may be endangered.

We have already referred, in passing, to the relations between a public speaker and his hearers. We have seen why some men can take an audience as it were by storm, whilst their arguments, if taken down *verbatim* and quietly read over, are found impotent and worthless. In the former case any candid or impartial hearer who happens to be present is exposed not merely to the impulse derived from the brain of the speaker, but to that emanating from sympathetic hearers. Consequently to retain an even balance of

mind is no easy task. But there is here one point which M. Rambosson has overlooked,—a point in which moral contagions differ from physical epidemics. We know that in the one case, as in the other, persons of exceptional health and vigour, though exposed to the influence, come out unharmed. But healthy persons do not react upon a man suffering (say) from smallpox. His disease is not rendered either more virulent by their liability to infection, nor more benign by their immunity.

As regards moral contagions the case is different; persons may not only resist the movement, but may exert an opposing influence upon the brain in which it originated. Everyone must have noticed, or at least heard of, the different effects produced upon an orator according as he feels that his audience are with him or against him. In the latter case, even though there may be no overt expression of disapproval, yet the most hardened agitator feels his confidence diminish and his flow of sophisms become obstructed while suffering under stricture.

To take a case which we will not pronounce exactly analogous, let us turn to the records of spiritual manifestations. We find it stated, over and over again, that the presence of even a single obstinate sceptic prevented, or at least greatly limited, the phenomena which were expected.

Something similar occurs in cases of so-called magical or miraculous healing. Want of faith is declared a fatal obstacle. But if the views of M. Rambosson are correct, faith is simply a ready accord between the brain-movements of the operator and those of the patient. Knowing the various influences of the nervous system upon the entire living animal, we need feel little surprised that a physician who feels perfect confidence in the plan of treatment he is adopting, and who can impress that confidence upon his patient,—*i.e.*, who can induce in the brain of the latter a movement synchronous with that existing in his own,—should be eminently successful.

Turning once more to public meetings as the great means, in this country at least, for the propagation of moral contagion, we have often—on analysing the arguments of some agitator, and pointing out the baselessness of his premisses and the falsity of his conclusions—been met with the remark, "Yes, but you should hear him!" We reply, "No, my good friend: we are quite satisfied to read what he has to advance, without exposing our judgment to be warped either by the personality of the speaker or by the sympathy of his hearers." Facts, and legitimate inferences from facts,

can lose nothing by being written instead of uttered verbally. The moral is that those wish to judge a righteous judgment should eschew public meetings.

It will be seen, from what has been said, that the will may intervene either to resist or to assist a reflex contagious movement. It may either resist such movement entirely or partially, to a greater or less extent, either neutralising or developing the influence from without.

Further, we find that what the will has realised often, and in a conscious manner, may fall under the domain of the instinctive. We come to do instinctively that which, by the original instinct of the will, has passed into the sphere of habit.

We find likewise that actions which inspire fear may, up to a certain point, prevent or restrain the contagion which we are discussing, by determining the will to struggle against the reflex movement.

The facts which experience reveals are perfectly in harmony with theory, and with the consequences of the law laid down.

Hence it follows that whatever enfeebles the will renders the contagion more powerful. Children and idiots can oppose merely an instinctive resistance, and are more susceptible than rational men.

It is easy to understand that persons whose nervous system is weak, and at the same time very sensitive, very easily impressed, may be more easily led into these contagious reflex actions, as indeed into reflex actions in general.

There are likewise persons who have a natural predisposition to certain reflex actions, and whose will to resist is either almost null, or who at least have not been trained to exercise this faculty. Here again are causes which render reflex action more easy and more energetic, and which consequently promote the contagion with which we are engaged.

It is easy to see that such predispositions may be acquired by exercise and habit, and it is even proved that when once acquired they may become hereditary.

Hystero-epilepsy, and the phenomena at once so strange, so delicate, and at the same time so complicated, by which it is accompanied, have been placed in a full light by Dr. Charcot. It may even be said that the distinguished professor of clinical medicine at the Salpétrière has left nothing obscure in this region. In order to be convinced of this it is merely requisite to attend his lectures. The profound studies which Rambosson has made in this direction have

shown how these morbid conditions where the phenomena are isolated, restricted, or exaggerated, according to circumstances, corroborate the law of the transmission and transformation of the expressive movement and of the reflex action to which it gives rise, whilst at the same time the law gives the reason of the phenomena.

By generalising these notions, which are very simple, we may explain all those apparent contradictions which the contagion of nervous phenomena may present, and reply to all objections which may here be raised.

We will confine ourselves here to recall to mind that the law of the transmission and transformation of expressive movement as expounded above proves to be of an unexpected fecundity, for it explains the propagation to a distance, and the contagion of all the phenomena, all the affections, which have a cerebral movement as their point of departure.

Further, by showing that a cerebral movement is transmitted from brain to brain without losing its nature, and that to an identical or analogous cerebral movement there correspond identical or analogous phenomena, psychological and physiological, we have given the strictly scientific solution of a great number of problems which have hitherto been considered as inexplicable, and which have been banished into the most abstract regions of Philosophy,—such as the essential character of natural language in man and in other animals; the reason of its spontaneous comprehension, at all times and in all places; the special character of conventional language and its properties; the reason of the spontaneous comprehension of music and of all the fine arts; the nature and the explanation of their influence, physical and moral; and their part in hygiene and in therapeutics.

This law is founded upon no hypothesis, but upon a rigorous scrutiny of facts. The author claims the right of insisting on this point, since he has been so scrupulous as not to touch upon many questions which he is persuaded belong under this law, such as most of those which have reference to animal magnetism and to somnambulism. He has observed this precaution in order that the obscurity which rests on these subjects may not give a pretext for misinterpreting the facts which he has brought forward.

We may now proceed to a general summary. In order to demonstrate the principle of the contagion of nervous phenomena, intellectual and moral, it has been necessary to

establish as preliminaries certain points which are based upon the most advanced data of different sciences.

1. In our studies the grand problem of the transformation of motion has taken, we believe, a step in advance. We have proved that the transmission and transformation of motion may be effected in a number of cases, and in particular in the cases in question, without the movement losing its co-ordination. On being transmitted to different media, cerebral or psychic, then purely physiological and physical, then again physiological and psychic or cerebral, it presents in the different media different phenomena, but on repassing into the same medium it reproduces the same phenomena—the movement appears co-ordinated in the same manner. We are, indeed, thus led to ask if the mythic Proteus does not symbolise knowledge formerly possessed, then lost, and finally re-discovered.

2. On accurately summing up the most recent physiological discoveries we are necessarily led to consider the organisation, in its most general functions, as being merely a conductor and transformer of motion, and to find that we only reach the *sensorium commune*, the *ego*, by motion, and that the *ego* only manifests itself or responds by motion,—a motion special and co-ordinated for each phenomenon. When the organs are diseased they affect the nature and the conductivity of this movement in different manners. Hence the perturbation remarked in the psychic phenomena.

3. We have brought the fact prominently forward that to a given cerebral movement there always correspond identical and analogous phenomena. Thus the cerebral movement which produces laughter is not the same as that which gives rise to yawning, &c.

4. The cerebral movement transmitting itself from brain to brain, through the ambient medium, without losing its nature, must consequently reproduce—or tend to reproduce—in any other brain which it reaches all the phenomena which depend upon it in the brain where it originated.

5. The ordinary ambient physical medium which serves as intermediary for a cerebral movement in passing from one person to another are the sonorous and the luminous vibrations. [Also the olfactory movements?] We have studied the movements, and the relations of these various waves, and found that they concur perfectly in the reproduction of the same phenomena,—that they may act separately or simultaneously, in spite of the difference in their nature and the diversity of their rates of movement. They are added together when they act simultaneously to reproduce

one and the same cerebral movement, and consequently the physiological phenomena dependent thereon. The author has left no obscurity in this demonstration, which is of a twofold nature, being founded firstly on direct observation and experiment, and secondly on careful studies made upon blind or deaf persons.

6. Thanks to the facilities which Science now places at our disposal, we can follow the cerebral movement from stage to stage without losing sight of it for a moment, and can demonstrate its identity.

7. Just like the nervous phenomena with which we have been occupied, intellectual and moral phenomena are only manifested at first by cerebral movements, the brain being the seat of all the psychic faculties; this, being scientifically established, cannot be contested by anyone. Hence it follows that the phenomena due to these faculties become contagious by the propagation of the movement which is peculiar to each of them, and which passes from brain without losing its nature. They all come consequently under the same law of propagation, whatever may be the difference of nature observed among them.

8. We have seen that the cerebral movement is, as regards psychic operations, *sometimes cause and sometimes effect*. It is the *cause* when it is produced by an external movement. By acting on the psychic faculties it gives rise to sensation, perception, &c. It is *effect* when the *Ego* acts or reacts,—when it thinks, loves, wills, &c.,—in a word, when it acts in any manner whatsoever. It produces then a cerebral movement which is propagated outwardly, and which reveals what is passing within.

9. When the reproduction of the phenomena which occupy us takes place, as it is determined by the movement which passes from brain to brain, there is then a reflex action,—the movement from centripetal becomes centrifugal. It is therefore this direct action which is the *immediate cause* of the contagion which we are studying.

10. This reflex action is distinguished from every other because the origin of the physiological movement which gives rise to it is found in a foreign organism, whilst ordinary reflex action is produced by a centripetal movement having its physiological source in the same person in whom the action is manifested. This indirect reflex action—*in Distans*—is then very remarkable for the origin of the movement which determines it, and must be specially distinguished from every other.

11. If we study with care the circumstances which are in connection with that reflex action which produces contagion, we see that some of them are common alike to it and to direct or ordinary reflex action, whilst others are peculiar. Here are some of the conclusions at which the author has arrived on this point:—

The reflex movements which produce contagion are sometimes conscious, sometimes unconscious. They may be automatic, instinctive, or, on the other hand, conscious and voluntary. They may even sometimes change their nature, passing from the instinctive to the conscious and voluntary, or inversely.

Various simultaneous or successive movements may be produced in an assemblage of individuals, and may give rise to reflex movements concurring to some common object. In the military state especially these facts may be produced in a signal manner.

A contagious reflex movement under the influence of the same causes is not produced equally and always in all persons. We have explained these facts, as well as the influence of repetition upon reflex action.

Furthermore, one and the same reflex action may, according to circumstances, produce effects quite opposite. We have cited above certain instances, such as the sound-waves of a military march; the action which they tend to produce aids those who have to act by saving them the fatigue of a direct movement, and wearies those who wish to remain quiet by compelling them to resist the reflex action. By generalising these diverse and opposite actions of one and the same contagious reflex movement, it is easy to explain scientifically all the apparent contradictions observed in nervous, intellectual, and moral contagions, and to throw a light upon the most obscure points.

12. By following out this order of ideas it is easy to see that man is not subjected by necessity to the contagion of the phenomena in question, but that by a direct movement he can struggle against the contagious reflex action, and may either neutralise it in part or completely, or, on the other hand, may allow it to become developed.

IV. THE PROPOSED AMERICAN EXHIBITION IN LONDON."

By an Old Technologist.

"Competition, in the sphere of industry and commerce, has become a war to the knife."—*Kölnische Zeitung.*

THAT a nation should get up a display of its own products, whether natural or manufactured, is in these days an event common almost to staleness. But to hold such an exhibibiton, or "exposition" as it is termed, of writers of un-English in a foreign country, is indeed original. But, though by no means wedded to precedent—to old use and wont—I cannot look upon this innovation in the light in which it is viewed by no small portion of the British press. To prevent misconceptions, or rather misinterpretations, let me say that, as far as science is concerned, I am a complete cosmopolitan. In that field the rivalry between different nations seems to me perfectly honourable, and even friendly. Thus, while regretting that Germany produces a greater quantity of research than does Britain, I wish not that she should do less, but that we should do more. I hailed the proposal, which has been successfully carried out, of holding this year's meeting of the British Association across the Atlantic. If Captain Bedford Pim's suggestion that in 1887 the American Association should meet in London becomes a reality, no one will rejoice more sincerely than shall I. And if an International Association is formed I shall be still better satisfied.

But between science and what is commonly, though not happily, termed applied science, there is a heaven-wide gulf, so that from the one we cannot argue to the other. Applied science, or rather industrialism, is now more and more plainly becoming merely a phrase of war. Indeed, no small part—and, I fear, an increasing part—of its energies is now turned towards "improvements" in the art of "war," taking that term in its old and narrower sense. But if we define "war" as any process by which one nation seeks to injure another for the sake of some real or supposed benefit to itself, we shall find that modern industrialism is war all over.

Time was—or rather, perhaps, certain amiable enthusiasts such as Elihu Burritt, dreamed of a time when commerce, based upon the division of labour, should be a bond of union between nations, the prosperity of one being essential to the well-being of its neighbours. It was supposed that one people might say to another, "I have a fertile soil and a genial climate. I do not care to live cramped up in cities amidst the dust and dirt and din of manufactures; let me, therefore, supply you with corn and fruits, wine and oil, healing drugs and dye wares, whilst you in return furnish me with hardware and clothing, glass and pottery."

This spirit, if ever it existed, has almost entirely exhaled. Almost every nation aims at being entirely self-supplying at once with raw materials and with manufactured goods. In order to exclude foreigners from its markets, as sellers, it is even willing to pay a notably higher price for many of the requisites of civilized life, thus paying what may be called a subsidy to its manufacturers and a kind of poor's-rate in augmentation of wages to its workmen.

Into the wisdom or folly of these arrangements it is not the place of the "Journal of Science" to enter. A nation may, perhaps, find it advantageous to bear severe losses and sufferings in the hope of inflicting severer losses and sufferings upon a rival. This is the very *rationale* of war, and I notice it merely to show how completely modern competitive industrialism is, in its very essence, war!

In their endeavours to exclude foreign goods from their markets the United States have been more systematic and more determined than perhaps any other nation. They are the champions of protectionism as decidedly as Britain has been the representative of free trade. Perhaps it may be said that they legislate for the world as they find it, whilst we are given to regulate our laws and our institutions in accordance with some Utopia existing only in the dreams of orators. Be this as it may the United States even impose taxes on foreign scientific books and journals, lest the American paper maker, printer, &c., should suffer some infinitesimal loss by being thus exposed to a fractional competition with European countries. And such taxation still finds its advocates in a country where the revenue shows no signs of falling off.

American protectionism, moreover, seems to be especially directed against Britain. If we read the many flourishing trade journals published in the United States we cannot fail to be struck with the bitterness of spirit in which the question of free trade *versus* protectionism is discussed. To

supplant British manufactures at home and abroad is one of their chief objects, and every step taken in that direction is the subject of no little jubilation. If anyone doubts this he need merely glance over the American papers representing the paper trade, the chemical, textile, iron, and glass manufactures, &c.

At the same time, curiously enough, what is sauce for the goose is not accepted as a legitimate sauce for the gander. It is all right and proper for European products to be excluded from the American market, but legislation for the exclusion of American bacon and hams from the European continent on account of the alleged presence of trichinæ gave rise to much ill-feeling in the United States.

Still such inconsistency is a part of human nature in all countries. I once met with a Midland farmer who was indignant that French butters should be sold in England as "genuine Aylesbury." At the same time he could see nothing objectionable in condensed "Swiss milk" manufactured at Aylesbury.

With reference to this threatened exhibition, it should always be borne in mind that in these great advertising displays all nations do not stand on an equal footing. A free-trading people is heavily handicapped in comparison with a protectionist rival. The protectionist, if he sees anything desirable in a foreign display, does not seek to import it, for his tariff laws may make that commercially impracticable. He seeks, instead, to introduce its manufacture into his own country. On the contrary, if he can show anything desirable to free traders they are willing and able to buy it. Hence a free-trading country has much to lose and little to gain by exhibitions, especially if it makes a display not merely of finished goods but of the machinery and the processes by which they are produced.

There is another inequality between the free-trader and the protectionist which, at an exhibition, tells heavily against the former. He has to produce his goods—say printed calico—"at a price," as the trade expression runs. Hence he is often debarred from using the best materials and employing the greatest skill. He is sometimes even debarred from experimenting by the same condition. On the contrary, the protectionist can get his own price, can thus afford to employ superior materials and a higher class of labour.

These incidental drawbacks of free trade in connection with exhibitions have not, I believe, received the attention of economists. But they are, in my opinion, sufficient to

place Britain in a disadvantageous position as regards international displays, and to make them, for us, undesirable. But still less desirable is the proposed gathering. The "British Trade Journal" goes so far as to remark, "There may be, in a few quarters, remarks as to the illogical position of a country which maintains prohibitive tariffs and endeavours, at the same time, to find a market for its productions abroad; and it may even be asked if the United States wish us to take not only their corn and their fruit, but also their manufactured goods, what, in the name of all that is reasonable, are they going to take in return? This is a question which such an exhibition as that proposed will assuredly bring up." That a trade which it is sought to make entirely one-sided must come to an end needs no demonstration. If we cease to be producers, or what amounts to the same thing, if no one will buy our products, we must perforce cease to be consumers. There are some persons who calculate that if our foreign commerce goes on declining at its recent rate for twenty years longer, it will have reached not the beginning of the end, but the end itself.

After these preliminary considerations, I come to the two main questions, viz., what are the objects which the United States have in view by the proposed exhibition, and what is the especial time which they have selected?

It is expected, we read, among other things, to "stimulate emigration to the United States." It is to be an "encouragement to the emigration of the better class of English farmers, very few of whom have yet come to this country (America) and who would better themselves by coming, besides being very desirable citizens." "It will," says General C. B. Norton, the chief promoter of the scheme, "if properly managed, largely encourage immigration." "This," says the "Manchester Textile Recorder," will be an immense advantage to the crowded population of this overcrowded country, who must eventually seek in other lands the means of subsistence they are unable to obtain here."

Many more similar admissions might be quoted, were it needful, to prove that the drawing off to the United States of a portion, and that not the worst portion, of our population, is one of the cardinal points aimed at.

But another mark is British capital. Says one paper, "Capital is seeking for new outlets, and if it can be shown that there is a profitable return, in land transactions and industrial enterprises in the far west, there is little doubt that investments will be readily made."

"To our mind," says an American organ—not one of those dreadful parlour organs which make life not worth living in the two next houses—published in London, "the most important section of this exhibition will be that devoted to showing the advantages of the newer states and territories for the investment of capital." Again, "through this presentation the attention of foreign capital will be attracted to the great railway and mining interests of this country." Passages of similar nature might be multiplied indefinitely, all tending to show that *a* great, if not *the* great, object in view is the attraction of British capital.

The third great object of the promoters is to increase the sale, not so much of American raw material as of American manufactures. Says one American authority, "There can be no better way possible for American producers to introduce certain lines of goods to the British public than through a great exhibition devoted entirely to American products to be held in the metropolis of Great Britain." One American paper writes, "It would open up for us new and profitable markets." Another thinks "the enterprise will have a tendency to open up markets for us in Europe." A third considers that "it cannot fail to be of great advantage to our industries and lead to an increase in our export trade."

An English paper which decidedly favours the scheme writes, "The Americans have everything to gain from such an exhibition." This I shall not dispute; but suppose that the intended demonstration should be successful, what have we to gain or to hope? I shall, of course, be censured for thinking, at such a juncture, of so despised a matter as "British interests." But how will they be affected? Can American manufacturers and merchants do more business in this country without depriving British manufacturers and merchants of some part of their business? and is this to be desired? If the United States were a free-trade nation I might be told in reply that the more of their produce the Americans can sell in Britain the more of our manufactures they will buy in return. But they are not free traders, and they are constantly seeking to still further lessen their imports of British goods. Hence I see but scanty hope that any increase of trade between Britain and the United States will be other than one-sided.

I must now turn to the other two purposes of the Exhibition, the attraction of British emigrants and of British capital to the American Union, and ask how far these aims are compatible with our national interests? It must be

freely admitted that, as the "Manchester Textile Recorder" has it, we have a population "in this over-crowded country who must eventually seek in other lands the means of subsistence they are unable to obtain here." It may also be true that there is British capital which is unable to find remunerative investment within the narrow limits of the United Kingdom. But does it follow that either our surplus labour or our surplus capital must be drafted off to America? This consideration brings us to the particular point of time selected by General C. B. Norton and his colleagues for their undertaking. We all know that it has been officially announced through H.R.H. the Prince of Wales that in the year 1866 there will be held at South Kensington an exhibition for bringing before the home-public the productions and the resources of those portions of the British Empire which we still call by the chilling names of colonies and dependencies, and which too few of us have yet learnt to regard as portions of our home, part and parcel of the birthright of the British people and their *socii*. The avowed purpose of this exhibition is to attract both capital and labour to Australia, New Zealand, South Africa, the Dominion, and capital, at least to India, the West Indies, &c. These regions are, taken collectively, far vaster than the United States, and certainly not inferior to them in the extent and variety of their resources. The objects of these two exhibitions are therefore diametrically antagonistic. The one is seeking to draw our labour and capital away to an alien land, whilst the other seeks to retain them within what is, strictly speaking, a part of our country. The American exhibition seeks to increase our (import) trade with the United States; the colonial exhibition seeks to extend both our import and export trade with the "colonies" and India. It is self-evident that the success of the one implies, *pro tanto*, the failure of the other. It is no less evident to which the sympathies of every true Briton must be given.

I do not know, and I have no right to assume, that the promoters of the American exhibition were already aware of an intended colonial exhibition when their scheme was first announced, in which case they would have been guilty of a grave act of international discourtesy. But in any case the coincidence is to be profoundly regretted, and I am far from concurring in the opinion of "The City" that England is "the most favoured nation," and that "we must consider ourselves very fortunate." All that remains is to strain every nerve to render the Indian and Colonial exhibition the more attractive and the more telling of the rival displays.

V. A NEW THEORY OF GRAVITATION.

By Robert Bell.

IT is with a great deal of reluctance that I lay before you an article which I hope (perhaps vainly) will enable Science to look into the secret chamber where gravitation has for so long a time concealed its mysterious power.

I say with reluctance, because if my theory of gravitation and planetary locomotion is correct it necessarily does away with former theories, admitted but not understood,

The force of gravitation is believed to be great, beyond the limit of human comprehension; but any effort to find it, to be successful, must be at the other extreme, because that power called Gravitation is in reality so small that it has hitherto escaped observation.

Be not startled, therefore, when I venture to assert that the Sun has no power in an attractive sense; that every cosmical body contains the means of its own locomotion; and that, although the Sun causes the Earth to describe a circle, instead of flying off in a straight line, it is done by quite a different process than by attraction. Let it be granted that Nature does all its work with the most simple means, and let us admit that weight gives motion,—that power is required only when there is resistance to be overcome; and let it be fair to assume that there is nothing where it cannot be proved that something exists: then if it is fair to assume that nothing exists where it cannot be proved that there is something, there is no universal atmosphere. If there is no universal atmosphere the Earth is suspended in absolutely pure space; and if the Earth is suspended in pure space there is no resistance to be overcome in putting it in motion: then it is plain that, if there is no resistance, an almost infinitely small power, if applied to it, would put it in motion. Now where are we to look for this small power? Revealed Science points the way.

There is no force without a corresponding reacting force. Experiments with the radiometer show that radiation is a force; consequently we find that power in the reacting force of its own radiations. If these radiations were perfectly equal, from every part of the Earth's surface, the reacting force would be perfectly equal also, and this would produce centripetal force, or what is called gravitation, by inclining

everything to its centre; but the Earth itself would remain stationary. I have thus accounted for centripetal force: now where shall we look for centrifugal force?

It is plain that, if the Earth's radiations were not perfectly equal all around, it would recede in the opposite direction to where they were strongest. Then comes the part the Sun does. The heat of the Sun destroys the evenness of the Earth's radiations by giving extra food for radiation, now at one part and again at another, thus giving it a forward motion without materially affecting its centripetal force.

We have only to look at the circular motion a billiard ball describes when struck on the side by an expert, or the elliptical orbit pursued by a ball on the bowling alley, when thrown by a master hand, or even the peculiar course followed by the boomerang as it speeds along, its different sides ever changing their relation to the surrounding atmosphere.

We have only to look at these to get at least a vague idea how the Earth describes a circle by means of its varied radiations. While the reacting force of the planets' radiations perform the functions above described, *their* radiations have a part to perform. These radiations prevent them coming into collision by repelling each other.

Thus we see the wisdom of the Creator, who doeth all things well. The bodies of the universe are all a piece of perfect machinery, made by a master hand, and do not require to be watched or wound up to keep it in order.

VI. MR. S. BUTLER'S CONTRIBUTIONS TO THE QUESTION OF EVOLUTION.

OUR readers may remember that we have on former occasions noticed some of the works of Mr. S. Butler —too favourably if we may judge from certain letters of remonstrance which we have received. The time has now come when an estimate of his services or disservices, as regards the great theory of Evolution, may be fairly attempted.

It need be merely mentioned that Mr. Butler, though a decided Evolutionist, is an equally decided rejector of the principle of Natural Selection. This rejection he has recorded in very plain language, going so far as to assert that Mr. Darwin and his colleagues and followers have left the doctrine of Evolution in a less intelligible state than they found it. He traces instinct—not unhappily—to inherited memory. He makes a great point of the distinction between conscious and unconscious knowledge, asserting that so long as we are conscious of our knowledge such knowledge is imperfect.

Passing over many other instances adduced as illustrations, we will select the following in virtue of its familiarity:—"Taking, then, the act of playing the piano as an example of the kind of action we are in search of, we observe that a practised player will perform very difficult pieces apparently without effort,—often, indeed, while thinking and talking of something quite other than his music. . . . He finds it difficult to remember even the difficulties he experienced in learning to play. A few may have so impressed him that they remain with him, but the greater part will have escaped him as completely as the remembrance of what he ate or how he put on his clothes this day ten years ago; nevertheless it is plain that he does in reality remember more than he remembers remembering. . . . We draw the inference, therefore, as regards pianoforte or violin playing, that the more the familiarity or knowledge of the art (mark the term art!) the less is there consciousness of such knowledge. . . . On the other hand, we observe that the less the familiarity or knowledge the greater the consciousness of whatever knowledge there is. Conscious knowledge and volition are of attention; attention is of suspense; suspense is of doubt; doubt is of uncertainty; uncertainty is of ignorance; so that the mere fact of conscious knowledge or willing implies the presence of more or less novelty and doubt."

It may here be objected that Mr. Butler is confounding two different kinds of knowledge, or rather two things which are unfortunately confounded under the term "knowledge." There is the knowledge which expresses itself in art, and which may and does become unconscious as it reaches perfection. There is the knowledge which when organised becomes Science. And these two are not one.

It is a fearful mistake to assert even that, in the sphere of practical art, if a man can do a thing he knows how to do it,—*i. e.*, that he knows the principles upon which it is

done. Let us take an instance which has in former days come under our personal observation. Here is G. K., blue-dyer at the Dash-wheel Works. He can set a warm-indigo vat and work it, turning out well-dyed cloths, rarely making a mistake, and keeping his vat in good working order. But does he know the principle of any one step in the process? Did he ever know it? Did the master to whom he was apprenticed ever know it, or his forerunners back to the earliest times when indigo-vats were worked in ancient India? Most emphatically no! He knows nothing of the transmutation of indigo-blue into indigo-white, or by what agency it is reconverted into indigo-blue after being deposited on the fibre. He knows by odour and colour when his vat is working right, and when it is sick; but he never thinks that the right and the wrong conditions are due to the action of certain ferments, and that it is possible to cherish the one and to repress the other. Lastly, not to prolong this illustration, he can, if he has had a quarrel with his employer, occasion much trouble by throwing lumps of copper sulphate into the vats. But he has not the faintest idea how this mean piece of rattening acts. He does not know that salts of copper have the power to transfer oxygen from the atmosphere to organic matters with which it is in contact, thus converting the soluble white indigo into the insoluble indigotine, when it has no longer the power of attaching itself to the wool.

Lastly, it is well known that in the art of indigo-blue dyeing, as well as in dyeing cochineal-scarlets, a variety of improvements have been made. The process has been simplified, and a variety of useless ingredients have been omitted. But has this ever been done consciously, or with increasing perfection has it come to be done unconsciously? We trow not: a number of fortuitous steps—very much as in the supposed formation of species by Natural Selection—have led up to the present state of the art. Some one of the useless ingredients was accidentally omitted, or the supply fell short, and the dyer, going to work without it, obtained as good a result as if he had followed the old traditional receipt. But why this or that ingredient was needless he never asked. There was also in dyeing, as in other arts, experimentation, but it was a blind tapping,—again like the action of Natural Selection.

But when a really great improvement was needed, men of conscious knowledge were needed. Schützenberger and De Lalande discovered a process by which oxygen could be withdrawn from organic matter, both efficaciously and regu-

larly, without the complex and often apparently capricious action of ferments. It struck them that this process might be applied in indigo-blue dyeing, and they succeeded, rendering the process henceforth easier and more economical.

In like manner it might be shown that the chief improvements in other arts have sprung from those whom the world calls "men of Science," but to whom Mr. S. Butler refuses that title. Indeed it seems scarcely uncharitable to suggest that Mr. Butler would never have launched into his depreciation of conscious knowledge, save with a purpose—perhaps scarcely conscious—of dealing a side-blow at the scientific world, with whom his relations are not too amicable.

Let us, for instance, weigh the following passages:—"Our conception of the words 'Science' and 'Scientific' must undergo some modification. We should recognise more distinctly than we do that there are two distinct classes of scientific people. . . . The one class is deeply versed in those sciences [it should be *arts*] which have already become the common property of mankind; enjoying, enforcing, perpetuating, and engraining still more deeply into the mind of man acquisitions already approved by common experience." ["Enforcing, perpetuating, and engraining"—the work of the pedant.] . . . "While the other class is chiefly intent upon pushing forward the boundaries of Science, and is comparatively indifferent to what is known save in so far as necessary for purposes of extension. . . . Surely the class which knows thoroughly well what it knows, and which adjudicates upon the value of the discoveries made by the pioneers,—surely this class has as good a right, or better, to be called scientific than the pioneers themselves." The author is here, surely, carrying his love of the paradoxical to an unwarrantable extent! But we find something yet more deplorable to follow. Mr. Butler thinks that the class whom he designates "scientific people" are "neither progressive nor aggressive, but quite peaceable people, who wish to live and let live as their fathers before them. . . . Others, whose services in this last capacity [discovery] have been of inestimable value, are noticeably ignorant of the sciences which have already become current with the larger part of mankind,—in other words, they are ugly, rude, and disagreeable people, very progressive, it may be, but very aggressive to boot."

It would be difficult to imagine a wider departure from the truth. The man of pure Science is of all men the least aggressive. So long as you do not deprive him of time and materials he will never interfere with you or your ways.

On the contrary, the other portion of mankind, who enter into the race for wealth or power, are *not* willing to live and let live. It is they who are the invariable and necessary aggressors.

We now come to the error, as it seems to us, which underlies Mr. Butler's whole scheme of evolution. He writes:—"A man shows that he knows how to throw the boomerang by throwing the boomerang. No amount of talking or writing will get over this." On the contrary, it is easily got over; the fallacy lies in the double sense of the word "*knows*." Mr. Butler continues, "*ipso facto*, that a baby breathes and makes its blood circulate, it knows how to do so!" Now, if we compare this case with that of the violinist we see at once a world-wide difference.

The violinist may be able to execute a difficult piece of music without conscious effort, automatically. But we know that there was a time when every note cost him a conscious effort. As regards the young animal, Mr. Butler admits that "it is less obvious when the baby could have gained its experience, so as to remember exactly what to do." We go much further; the baby can never have had a conscious knowledge of the processes of breathing or circulation, either in its own person or in that of its ancestors, human, semi-human, or brute.

We now come to the question of teleology. In opposition alike to Charles Darwin, along with most modern biologists, on the one hand, and to Paley and his admirers on the other, Mr. Butler admits "design," but maintains that "the design which has designed organisms has resided in and been embodied in the organisms themselves.

This view, he contends, was first suggested by Buffon, improved and made "almost perfect" by Erasmus Darwin, and borrowed from him by Lamarck, "though somewhat less perfectly comprehended by him than it had been by Dr. Darwin."

But how does he, an evolutionist not unversed in the truths revealed by embryology, succeed in saving the "design" idea at all? For he quotes that passage in which G. H. Lewes not merely crushes, but absolutely decomposes, Paley:—"None of these phases have any adaptation to the future state of the animal, but are in positive contradiction to it, or are simply purposeless; whereas all show stamped on them the unmistakeable characters of ancestral adaptation and the progressions of organic evolution. What does the fact imply? There is not a single example known of a complex organism which

has not been developed out of simpler forms. Before it can attain the complex structure which distinguishes it, there must be an evolution of forms similar to those which distinguish the structure of organisms lower in the series. On the hypothesis of a plan which prearranged the organic world nothing could be more unworthy of a supreme intelligence than this inability to construct an organism at once, without making several previous tentative efforts, undoing to-day what was so carefully done yesterday, and repeating for centuries the same tentatives in the same succession. There is a traditional phrase much in vogue among anthropomorphists which arose naturally enough from a tendency to take human methods as an explanation of the Divine—a phrase which becomes a sort of argument —"The Great Architect." But if we are to admit the human point of view, a glance at the facts of embryology must produce very uncomfortable reflections. For what should we say of an architect who was unable, or obstinately unwilling, to erect a palace except by first using his materials in the shape of a hut, then pulling them down and rebuilding them as a cottage, then adding storey to storey and room to room, *not* with any reference to the ultimate purposes of the palace, but wholly with reference to the way in which houses were constructed in ancient times. · · · Yet this is the sort of succession on which organisms are constructed. "The embryo is nothing like the miniature of the adult. For a long while the body, in its entirety and in its details, presents the strangest of spectacles. Day by day and hour by hour the aspect of the scene changes, and this instability is exhibited by the most essential parts no less than by the accessory parts. One would say that Nature feels her way, and only reaches the goal after many times missing the path."

Yet, in the face of this utterly overwhelming argument, Mr. Butler still believes that the "evidence for design is not affected. He gives a counter-illustration—quite incapable of being supposed—of a law deed which the draftsman had commenced as a marriage settlement and then converted into a will, and which yet was found to *work with ease and simplicity in practice* (!) And he thinks that an observer "would not, in the face of the result, deny the design." Yes; he would conclude that the draughtsman was either mad or drunk, certainly not guided by any rational purpose. In the words which we have italicised the question is in some sort begged. For if we turn from embryology to morphology we find that the result, *i.e.* the human system,

is not satisfactory. What of the vermiform appendage of the cæcum, which answers no purpose save occasionally to produce a painful death. What, above all, of the many points in which, as Dr. Clevenger has shown (see "Journal of Science," March, 1884, p. 134), the adaptation of man to an upright attitude is far from complete? Surely such facts put design out of court, and leave merely a something which to us—who are designers—simulates design.

VII. THE SIGNIFICANCE OF HUMAN ANOMALIES.

By Francis J. Shepherd, M.D.

[The following article, communicated by its author to the "Popular Science Monthly," forms such an important contribution to the evidences of Evolution that we think it our duty to lay it before our readers.]

EVER since the study of human anatomy has attracted any attention, variations in the arrangement of the different structures of the body have been noticed. For many centuries the signification of these variations was not understood; and even as lately as 1840 Dr. Knox, of Edinburgh, who had the courage to state his conviction that they connected man with the lower animals, was looked upon, even by members of his own profession, as one prompted by the evil-one. In early times, when great prejudice existed against the dissection of human bodies, and animals, such as monkeys, dogs, cats, &c., were frequently used as substitutes, the similarity of some of their muscles to those which occasionally occurred in man as anomalies forced the anatomists to remark on them as being curious coincidences, though in their published works they drew no conclusions from their occurrence bearing on the origin of man.

In the view of our present knowledge of the animal kingdom and its development, and with the acceptance of the

great principle of Evolution, the explanation of these variations is simple enough, *viz.*, that they point to the fact that man has descended from some lower form, and "is the co-descendant with other mammals of a common progenitor" (Darwin).

Again, many structures which in man are merely rudiments and quite useless, nay, sometimes a source of danger, are seen fully perfected in some of the lower animals, and in them fulfil a definite purpose. The existence of such rudimentary organs (or, as Haeckel calls them, "worthless primeval heir-looms") as the ear-muscles, the appendix vermiformis in the intestines, the thyroid gland, the remnant of the third eyelid, the rudimentary tail-bones, and many others, is not satisfactorily accounted for on the theory of the plan of general unity; but if we look upon them as parts which have become functionless and atrophied from want of use, and by heredity have been transmitted from generation to generation, a bright light is thrown on the reason of their existence. In the present paper I do not intend to dwell on the significance of rudimentary organs which exist normally in man, but shall confine myself to those structures which occur as variations.

I might here mention that some parts, as for instance certain muscles of the thumb, occur in man, but not in the lower animals; these we may take as indications of the advance of man to a still higher development.

To the study of embryology we owe much in elucidating many morphological problems, and removing others from the domain of theory. By our knowledge of this most intricate subject the significance of many variations and rudimentary organs is made plain.

It has been well said that "the development of the individual is the compressed development of the race in the process of compression; some features are suppressed or modified, and others are thrown into relief." In the development of the embryo we see the history of the race, but the higher the form the more quickly does the embryo pass through those stages and transformations which are the equivalent of what is persistent in types below. In lower forms these stages are much less rapid, and in fact are true metamorphoses. The changes occurring in the development of the common frog will furnish a familiar example of this latter statement. The more we know of embryology the more the truth of the saying that "development means descent" is apparent.

It may not be generally known that no two individuals

have exactly the same anatomical structure, and that nearly everyone has in him some bony prominence, supernumerary muscle, or abnormal blood-vessel, which tells the tale of his descent. During the past nine years I have been teaching anatomy, and nearly three hundred subjects have been dissected under my immediate supervision: in these I have carefully noted the variations occurring, with the result of finding that scarcely one body is perfectly normal in every part,—nay, many are very abnormal, having as many as thirty to forty variations in their bones, muscles, or arteries. I have found variations to occur more frequently in Negro and Indian subjects than in those of European descent. When a variation in a bone, muscle, or blood-vessel is found, the first question asked is, What is its morphology? and it is the exception not to be able to make it out; if one fails it is concluded that our knowledge is deficient, and that the variation has a history, if we could only discover it.

Many variations are explained when an appeal is made to comparative anatomy, a science which is as yet very incomplete, but which is rapidly enlarging its boundaries. Some animals we know by their fossil remains, and in these merely their bony structure can be studied; all the soft parts are, of course, lost for ever, and can only be approximately restored by our knowledge of allied existing types of the same animals. With these few preliminary remarks I shall proceed to describe, as simply as possible, some anomalies I have myself met with, and the significance of which I shall endeavour to make clear.

Osseous System.—In a skull in my possession, whose lowness of type is manifested by the narrow forehead, prominent supra-orbital ridges, wide arches of bone to inclose the large masticatory muscles, the acute facial angle, prognathous jaws, and well-marked bony prominences, are two remarkable variations:—

1. An Epihyal Bone.—In all human beings there is near the ear-opening a bony spine, generally about half an inch long, and which is called, from its resemblance to an ancient pen, the styloid process; the lower end of this is connected with the hyoid or tongue-bone of the neck by a fibrous cord. Now, in this skull the styloid process is not connected with the little tongue-bone by a fibrous cord, but the styloid process is itself prolonged down to the tongue-bone and articulated with it in the fresh state. It is quite a large bone, 3½ inches long. This arrangement is seen in many of

the lower animals, and in them the bone, which is a very important one, is called the *epihyal bone.*

2. At the base of the skull on the left side, behind the mastoid process, the prominent nipple-shaped process behind the ear, is a stout, bony spur, more than three-quarters of an inch long, which has a downward direction, and articulates with the first bone of the vertebral column. This process is rarely seen in the human being, and is the only one I have met with, but it is quite the normal condition in most graminivorous and carnivorous animals, being especially well marked in the horse, pig, sheep, and goat. In them it is an important part, and gives attachment to strong muscles which move the head on the trunk. It is called the paramastoid process, from its proximity to the mastoid.

Supernumerary Ribs.—I suppose everyone is aware that the vertebral column, or backbone, is composed of many separate bones, some of which carry ribs. The backbone is made up of thirty-three bones,—seven in the neck, twelve in the trunk, five in the loins; below this we have a bone called the sacrum, which consists of five vertebræ fused together; and lower down still four small bones which represent the tail-bones, called, when taken together, the coccyx, from their supposed resemblance to a cuckoo's beak. Now each trunk, or dorsal vertebra, has two ribs connected with it, one on each side; so there are altogether twenty-four ribs, twelve on each side; but sometimes there are more, and, when this occurs, the extra ribs are carried by the neck (cervical) or loin (lumbar) vertebræ. I have specimens in my collection of both varieties, cervical and lumbar. These supernumerary ribs do not occur very frequently; still every anatomist has observed them. Their occurrence becomes more intelligible when we know that in crocodiles, birds, and the three-toed sloth, neck or cervical ribs exist normally; that in crocodiles, alligators, and some other animals, loin or lumbar ribs are never absent; and that in man traces of them exist in the muscles of the abdomen. In the human embryo, in an early stage, a rib is always seen connected with the seventh neck-vertebra, but before the fifth year of life it becomes blended with the ordinary transverse process; occasionally, however, this rudiment goes on developing, till it becomes a more or less perfect cervical rib.

Supra-condyloid Process.—It is not uncommon to find, in the humerus or arm-bone of a man, a hooklike process on the inner side of the lower end, having a downward direction:

this, with a band of ligament which connects its tip with the humerus lower down, forms a foramen or opening through which pass the great artery and nerve of the arm. This foramen is found in about 3 per cent of recent skeletons, but much more commonly in the skeletons of ancient races. In very many bodies a trace of this foramen is seen, represented by a very small bony prominence, or only by a band of fibrous tissue. In many of the lower animals it is the normal condition. It is seen in nearly all the Carnivora, except the plantigrades (though it has been found in the cave bear); it is also seen in monkeys, lemurs, and sloths. In these it is generally completed by bone, though in some by bone and ligament, as in man. In the animals above mentioned it serves the purpose of protecting the great nerve and vessel of the fore-limb from pressure during flexion, and it also affords a more direct course by which these structures can supply the parts below. In man when this arrangement occurs, owing to the altered position of the limb, the nerve and blood-vessel are actually dragged out of their course to pass through this opening; so in him it serves no useful purpose. This variation is, as was first pointed out by Prof. Struthers, well known to affect certain families. The only reasonable explanation of the occurrence of this structure appears to be that of reversion to the type of some mammalian ancestor in which this part was functional, or, in other words, served a definite purpose (Struthers).

Third Trochanter.—The third trochanter of the thigh-bone occurs about as frequently as the supra-condyloid process. On the upper part of the thigh-bone there are two prominences called the greater and less trochanter; a third prominence (*trochanter tertius*) sometimes occurs; it is situated a little below the great prominence, and gives attachment to the large muscle of the buttock (*glutæus maximus*). According to Fürst, in forty skeletons of Swedes examined by him in the Caroline Institute in Stockholm, fifteen possessed this process, and in six skeletons of Laplanders four had a third trochanter. I have seen it in only about 1 per cent of the skeletons I have examined. In many of the lower animals this process is enormously developed; it is very prominent in the horse and rhinoceros, and in many others it exists in a slighter degree.

One more example from the osseous system and I shall pass to the softer structures. In the human wrist are eight small bones called carpals, and arranged in two rows; occasionally between the two rows we have a ninth bone called

the os centrale. This os centrale is always present in the higher apes and some of the rodents. We also find that in every human fœtus, at an early period, a rudiment of this bone exists, but it has entirely disappeared by the fourth month of fœtal life.

Circulatory System.—Every naturalist now admits that the various stages of development of an animal, as well as its specialised parts, are often found to correspond with permanent conditions of animals lower in the scale. A good illustration of this is seen in the development of the human heart and blood-vessels. In the early stages of development we have a heart with a single cavity, connected with a vessel at each end, as in Ascidians; later on the blood-vessels consist of a series of arches which go to the gills or branchial clefts, as in fishes and Amphibia, while the heart consists of two chambers separated by valves, and is placed far forward in the neck. The gill-arches now partly disappear, and, though the circulation still remains single, as in reptiles, the heart-cavities are beginning to be separated into two distinct systems. Soon a double circulation is acquired by a complete separation of the heart into right and left. The right heart propels the venous and the left the arterial blood. At this period the condition is identical with that of birds; at last the true mammalian type of heart and blood-vessels developes, and remains permanent. The arrangement of the great blood-vessels going to and from the heart varies considerably in different mammals. In man the rule is for the great artery, carrying the blood from the heart to the general system, to give off three main branches, named the innominate, left carotid, and left subclavian. These are distributed to the head and the two arms; the main vessel or aorta curves downward, and distributes blood to the trunk and lower extremities. These branches are now known to be derived from certain of the original gill-arches which persist, and when any variation in their arrangement takes place it always occurs in the line of some of these gill-arches; that is, some of the arches persist which usually are obliterated. Nearly all the variations occurring in these large vessels in man are found to be the regular condition in animals lower in the scale; for instance, sometimes only two branches are given off instead of three; each of these, again, dividing into two, one for the head and one for the arm of that side. This is the usual arrangement in the bat, porpoise, and dolphin. The commonest variation of the aortic arch is where the innominate gives off the left

carotid, and so supplies both sides of the head, the artery supplying the left arm coming off as usual. This is the normal condition in apes, bears, dogs, and all the feline tribe. In some rare cases in man one branch only comes off from the aortic arch, and this, again, divides into the various arteries supplying the head and arms. In horses and other solipeds we see this form of aortic arch. Again, the branches may all be given off separately from the arch, as is the arrangement in the walrus.

I have three times met with rather a rare anomaly of the great veins going to the heart from the upper part of the body. The usual arrangement in man, on each side, is for the great vein of one arm and the corresponding side of the head to unite and form a single trunk (brachio-cephalic), so we have two large venous trunks, one on each side; these two trunks then join to form a single large vessel, called the superior vena cava, which empties its blood into the right side of the heart. It occasionally happens that the great venous trunks formed by the veins of the arm and head of each side do not unite to form the superior vena cava, but each continues its downward course and opens separately into the heart. On studying the development of the blood-vessels we find that in early fœtal life this condition of affairs exists, but after a time a transverse branch forms between the two trunks. This branch gradually enlarges, while the left trunk shrivels up, and at birth is only represented by a fibrous cord. This anomaly of the veins we find, then, is a persistence of a usually transient fœtal condition in man, and also that in all birds and many of the lower mammals it is the *permanent* condition.

Muscular System.—The muscular system of man is liable to many variations, nearly all of which are interesting from a morphological point of view.

It is not uncommon to find in man useless rudiments of muscles which exist in a well-developed state in some of our more humble fellow-creatures, and in them serve a definite purpose.

In man the "skin-muscles" are very feebly developed compared with those seen in many of the lower animals. The only remnants of these in man are,—the muscle which wrinkles the forehead (*occipito-frontalis*), the muscle immediately under the skin covering the side of the neck (*platysma myoides*), and the *palmaris brevis*, a little bundle of muscular fibres in the palm of the hand; not unfrequently remnants appear abnormally in other situations, as over the breast, in

the arm-pit, on the back, &c. The skin-muscles are well developed in those of the Mammalia which have loose skins, as, for example, the hedgehog, porcupine, and porpoise. In the hedgehog, when the skin-muscles contract, the animal becomes rolled up as in a bag of muscles. The sportive gambols of a school of porpoises are effected by an abundant supply of these skin-muscles; in the horse the skin-muscle is called the *panniculus carnosus*, and everyone who has seen a horse twitching its skin to get rid of troublesome flies will easily understand how serviceable it is to that animal.

In all human beings there is a small muscle going from a hooked process (*coracoid*) on the upper end of the shoulder-blade to the inner side of the arm-bone, about the junction of its upper and middle third. Sometimes this muscle is continued down to the lower end of the arm-bone; or, again, it may be quite short, and attached to the bag of fibrous tissue covering the shoulder-joint. On referring to the anatomy of the lower animals it is found that both these varieties exist normally, but in a much more highly developed state; they are especially well seen in animals which use their fore-limbs for digging, climbing, or swimming. In them the muscle is of large size, and reaches to the inner edge of the lower extremity of the arm-bone; in man, when it reaches thus far, it is only rudimentary, and of no use.

Another muscle which I have seen in about 3 per cent of human subjects is a small one which goes from the breast-bone to the upper end of the shoulder-blade. This muscle is well developed in animals which have no collar-bones; it reaches its highest development in the horse, pig, hippopotamus, and elephant. It is also seen in the Guinea-pig, Norway rat, and wombat. It is quite rudimentary when it exists in man, and serves no useful purpose.

In man, near the elbow-joint, and lying close together, are two muscles going from the upper to the lower arm; one in front (*brachialis anticus*), which helps to bend the elbow, and the other to the outer side (*supinator longus*), which supinates or twists the fore-arm outward. As a rule these muscles are quite distinct, though they lie side by side; but in about 1 per cent of cases they are joined together by muscular fibres. This is the normal arrangement in apes and monkeys, the union of these two muscles aiding them greatly in twisting their bodies when hanging by their fore-limbs to the branches of trees. Again, in apes, the muscle forming the posterior fold of the arm-pit is always prolonged down to the prominence on the back of the elbow. In the long-armed apes this muscle is especially well developed, and

serves to swing the whole arm rapidly and powerfully forward—a movement which is of the greatest importance for dexterously grasping remote branches while in the act of climbing. The same prolongation of this muscle is occasionally seen in man, though in a much less developed state, and serves to remind him of the arboreal habits of some of his not very remote ancestors.

In the gorilla, orang, and chimpanzee a muscle, called the elevator of the collar-bone (*levator claviculæ*), is always present: this goes from the upper neck-bone to the collar-bone. It is found in about 3 per cent of human subjects. Other muscles, occasionally found in man in a rudimentary and fragmentary condition, are ones going from the back of the head to the collar-bone or shoulder-blade; they are well developed in many of the Carnivora and Ruminants. I have seen them of large size in the lion, deer, &c.; in those animals they are much used in pulling forward the shoulder.

In about every other human subject is a small muscle going from a bony spur on the front of the haunch-bones to the muscles in the anterior wall of the abdomen. This is the rudiment of the great muscle in the kangaroo, opossum, and other marsupial animals, which supports the pouch where the immature young are carried, and the bony spur is the rudiment of a distinct bone, called the marsupial bone, which always exists in these animals, and gives attachment to the muscles which open and shut the pouch.

In man the short muscle of the foot which bends the toes is attached to the heel-bone, but occasionally the portion going to the fourth and fifth toes is separated from the portion going to the second and third toes, and is attached not to the heel-bone, but to the tendon of the long flexor of the toes. In the gorilla only one slip of this short flexor arises from the long flexor of the toes, but in apes we have as a normal condition the arrangement I have endeavoured to describe as that occasionally seen in man.

The brain of man is distinguished from that of the gorilla and the higher apes by having a greater relative size and being more complex. The different fissures are not so continuous, and are frequently bridged over by brain-matter. In the brains of criminals, the lower races of mankind, and idiots, according to Benedict, the fissures are very confluent in character, and in some the first frontal convolution is divided into two portions, as in apes. In animals lower in the scale than man, the little brain or cerebellum is more or less uncovered by the posterior lobes of the cerebrum or large

brain. This uncovered condition of the cerebellum was well seen in an idiot's brain that I lately had the privilege of examining; the fissures were also of the confluent type; the whole brain only weighed 16 ounces. The internal organs in man, although not subject to great variations, still are sometimes found abnormal. The liver may be divided into a number of lobes, as is seen in the gorilla. This is called a degraded liver. The spleen is often deeply notched and multiple, as in the case in some of the lower animals, and the uterus is occasionally double; an arrangement which is the normal one in the mare, raccoon, rabbit, and other animals. It is double in the human fœtus up to the fourth month, and frequently a trace of this bifid condition is seen in adult life.

I could multiply, *ad infinitum*, the variations in human anatomy which have their corresponding normal condition in the lower animals, but I think I have described a sufficient number of examples to show how common these animal resemblances are in man. On what theory can we account for their existence, except that they are reversions to some pre-existing and lower type? This is the only logical conclusion to which the study of morphology leads us, and "to take any other view," says Darwin, "is to admit that our own structure and that of all the animals around us is a mere snare laid to entrap our judgment."

ANALYSES OF BOOKS.

Can Man affect the Weather, or the Vapour Year. No author's name. Publisher (apparently) McLeod, 67, Port Street, Stirling.

"MAY it please your Majesty, I doubt the fact." In other words, before falling to work with Mr. Ruskin and with our author to seek out causes, either physical or moral, for the deterioration of the weather, let us be certain that such deterioration really exists. If believers in a change for the worse would only search old records, they would read of vapour years and of cold drizzly summers fully as bad as any which have occurred within the memory of the present generation. Let them, to go no further, read over White's "Natural History of Selborne." Or, if disposed to go a little further afield, let them peruse in "Ciel et Terre" an account of the fogs which prevailed over a great part of Europe during June and July, 1783. On the contrary, what do they say to the year which is now drawing towards its close? Can they find many instances of a milder winter, or of a hotter, drier summer? of more cloudless skies, and of a greater absence of fog? Again, in 1883, which if we mistake not is the author's "vapour year," the east of Europe enjoyed a brilliant and productive summer, whilst in Mauritius and Réunion we learn that the purity of the atmosphere was so complete that the satellites of Jupiter were visible with the naked eye.

Let not our anonymous friend misapprehend us; we are not pleading the cause of smoke. On the contrary, we hate it with a perfect hatred; but we do not wish that it should be wrongfully censured.

Turning to the pamphlet before us we find a very strange proposal. The author appeals to manufacturers to "cease their factories for one week only, and see if such benefits will not accrue in our atmosphere as to lead you to exercise your self-denial for three weeks longer in order to restore our sun to the earth, by which time you will see such effects as will abundantly reward you. . . . You will behold the face of Nature revivifying, you will be released from the burden of the poor!"

The author seems to forget that the owners of factories are not the only consumers of coal and makers of smoke. Probably one-half of our annual yield is burnt by railway companies, steam-ship owners, and by the British householder. Hence a mere stoppage of the mills, as was effected by a mob in the so-called "Holy Month" in 1842 (or 1843?) would be but a very

partial measure of relief. If our anonymous friend could induce the public to substitute German stoves (made of earthenware) for the present open fire-ranges the diminution of smoke would be probably still greater.

It must further be remembered that though the quantity of coal has vastly increased since A.D. 1800, yet as far as factories are concerned, at least, the increase of smoke has not been in the same ratio. There is the Smoke Consumption Act, which in practice effects the combustion and utilisation of a great part of what was formerly dissipated as smoke. The saving thus effected reaches, under careful management, 20 per cent. This Act, we know, applies only to steam-boilers. But the improvements with which the name of Siemens is connected realise also a great decrease of waste in our metallurgical works. Next, too, whilst the volatile products from coke burning were formerly let escape into the atmosphere, they are now more and more generally collected and sent to market.

It may seem a digression, but we cannot help here turning back to one of the benefits to be earned by "ceasing your factories." "You will be released from the burden of the poor." Now whenever a few factories have to stop for a short time, whether from a strike, a lock-out, a scarcity of raw materials (as in the great cotton famine), or a financial crisis, the very first consequence is an increase in the burden of the poor. Local taxation runs up, private benevolence is heavily strained, and shopkeepers are crushed with bad debts. We cannot, surely, conceive that the consequences would be less severe if the stoppage, instead of being confined to a county or two, extended to the entire kingdom, or to the whole civilised world.

As to the author's Physics and Chemistry, they are, we frankly admit, beyond our understanding. As instances we quote the following dicta :—"These doubtless [thunderstorms and heavy rains] were due to masses of smoke-hydrogen which the Sun finding in its way, in striving to get down to the Earth, had then power to ignite by violent shocks and in large masses. This, again, proves how cold is associated with carbonic dioxide; for when first brought down its first effect was to cause very severe winters. Owing to the then hardness of the oxygenised earth, the carbonic dioxide could not penetrate far down, but displayed itself in large masses of snow and ice. . . . The wind-influences, coming in contact with weighty hydrogen masses. . . . . We did not then recognise that our enormous quantities of rain were all due to these immense masses of the heaviest [*sic !*] hydrogen. . . . When the hydrogen commences to re-assert its power over the rarefied oxygen of the atmosphere, the nitrogen quits it, and under the Sun's presence, *flies upwards to the Sun itself*." The italics, we remark, are the author's own. A note in continuation of the last sentence adds—"Weighted with a little of this hydrogen. The Sun is attracted by the tiniest

nucleus of matter, and the four parts of nitrogen, each weighted with a little of this hydrogen [*sic !*] are sufficient to attract its rays. On its own surface it receives this hydrogen, and the oxygen ray which attracts it is detained by the nitrogen, enveloped in its fourfold power, and the weight of the oxygen thus shielded brings it down rapidly to the Earth."

For all these startling assertions there is no evidence, analytical or otherwise.

Egypt and the Wonders of the Land of the Pharaohs. By William Oxley. London: Trübner and Co.

The author begins by saying "It may be thought by the generality of people that there are quite sufficient books published on Egypt." But there is no other country—perhaps no other subject—which admits of being considered from so many sides. Mr. Oxley's own point of view is given in the following words, and it is one, we submit, which cannot be lightly passed over. He writes:—"I came to the conclusion that there was, and is, an affinity between ancient Egypt and modern Great Britain, which had either been unseen or ignored by previous authors. As a psychologist—more acquainted with the occult laws and phenomena pertaining to this science—I saw that without the recognition of this element in ancient Egyptian society more than the half remained unknown; and my chief object in publishing this work is to attract attention to this part of the social, political, and especially religious economy of Egypt, the elements of which, in past centuries, have been so deeply entwined in our own history."

Of course that decreasing portion of the public who are thoroughly satisfied in their own minds that the phenomena included anciently under the head "magical" were simply and purely delusions, will find in this book little to soothe their prejudices.

As a matter of course the Great Pyramid receives here due consideration. Mr. Oxley has no hesitation in assigning to its architect a more than ordinary human foresight and skill. He considers that it embodies in stone "the principles of geography, mathematics, meteorology, and astronomy," and that it further embodies "another and anterior science, the Science of Symbols, implying a knowledge of the *Intellectual evolution and prophetical history of Humanity*." Whilst discussing this subject he rejects as a monstrous fallacy the supposition that law is only applicable to the external phenomena of Nature.

In the account here given of the Great Pyramid we notice a

statement which the astronomy of the present day scarcely verifies :—"Astronomically considered *Alcyone* in Pleiades forms the centre of the astral system, and is the pivot around which our solar system revolves." This idea was suggested about forty years ago, but is now abandoned.

The author, whilst visiting the Pyramid and examining the so-called "Coffer," detected, or had his attention directed to, marks indicating that the stone had been cut by means of a circular saw,—a fact which throws a startling light upon the state of the mechanical arts in ancient Egypt.

It must be remembered that the author is far from accepting the theories of Prof. Piazzi Smyth. He agrees with the view of Mr. G. Massey that the so-called *Hyksos*, or shepherd-kings, were not foreign invaders, but native kings who upheld the ancient cults in opposition to the newer theology of succeeding dynasties.

Mr. Oxley calls our attention to the fact that Egypt was a settled and civilised nation ages before Assyria, Media, Babylon, Greece, and Rome came into being as great powers, and yet she still lives, while all these have passed away for ever. Such persistence must have been profoundly affected by its religious instincts. In Egypt these instincts were manifested in what the author terms a system of Super-naturalism, intertwined not merely with their social and religious, but even with their civil and political life. A belief in the intervention of controlling powers, outside the realm of Nature (?), was to the Egyptians a reality.

We here note that the author takes up a position somewhat strange in our days. He complains repeatedly of "the materialistic tendency which the teachings of modern *savants* are undoubtedly developing."

He admits that since those ancient times to which he has been referring "there has been a great advance in the adaptation of science and art to human requirements as far as mere earthly existence is concerned," yet he adds that "if this is at the expense of the spiritual perceptions and powers of humanity, it becomes a question whether it does not betoken a retrogression.

But we may here ask whether any agency or power can be rightly spoken of as outside the realm of Nature. We must also point out that the author, whilst referring to modern *adaptations* of Science,—many of which we should join him in pronouncing essentially evil,—says nothing concerning recent advances in Science itself.

Another significant passage is the following :—"Strange it is that the majority of our 'scientific' *savants* are so persistently opposed to what they choose to class as Super-naturalism,—meaning thereby the action of any law or power that does not come within the scope of the laboratory, or instruments made

by the hand of man,—as if, forsooth, there could be anything more scientific or irrational than to relegate the action of known natural laws to a blind force." But who limits the scope of the laboratory? What, too, is the author's definition of "law" as distinguished from "force"?

In proof of the real existence of magic the author gives a fearsome incident, which may be found in full in the "Theosophist" for January last.

Any satisfactory discussion of the doctrines thus more or less explicitly put forward would require an extent of space not at our disposal. But we think that whoever wishes to comprehend the recent revival of Occultism, and its possible bearings upon the future development of our race, will derive much benefit from a careful study of Mr. Oxley's book.

We are glad to find that the author utterly scouts the vulgar story of the destruction of the Alexandrian Library. Bishop Cyril and his monks, the murderers of Hypatia, are really the guilty.

On the Amount of the Atmospheric Absorption. By S. P. LANGLEY.

THIS pamphlet is a communication made to the American National Academy of Sciences, and reprinted from the "American Journal of Science." In it the author calls in question the ordinary value assigned to the absorption of the solar (and stellar) radiations of the Earth's atmosphere. This loss is given by a number of authorities, during the last and the present centuries, at figures differing but little from 20 per cent. So that, if these determinations are correct, supposing the sky be unclouded and the air normally transparent, four-fifths of the light and heat emitted by the Sun reach the Earth's surface at the level of the sea. Without impugning the accuracy of former observers, Mr. Langley shows that the assumption of Bouguer, Herschel, and Bouillet is incorrect, and that the absorption of light and heat by the atmosphere is a far more complicated process than they supposed. Experiment shows that like proportions are not absorbed by like strata, radiant energy being not a single emanation, but the sum of an infinity of diverse ones, each with its own separate rate of absorption.

The author then proceeds to demonstrate that the error occasioned by the ordinary assumption always tells in one direction, lessening the coefficient of absorption. By means of comparative observations made near the sea-level and at altitudes of nearly 15,000 feet he is led to infer that the mean absorption is double the usual estimate, or about 40 per cent.

Journal of the Society of Telegraph Engineers and Electricians. Vol. XIII., No. 53. London: E. and F. N. Spon.

This issue contains a most important paper, by Dr. W. H. Stone, on the "Physiological Bearing of Electricity on Health." The author begins with the admission that the whole question of electricity, as applied to physiological subjects, is in a state of great confusion. He writes:—"While electricity has been making bigger strides than any other physical science, the so-called medical electricity (I abominate the term, for there is no such thing; but I mean electricity as applied to physiology, and therefore to a certain extent to therapeutical pursuits and ends) has marvellously hung back, and it is certainly still in the ante-Faradaic period." One of the reasons which Dr. Stone gives for this backwardness is suggestive:—"The knowledge of physics and the knowledge of physiology is rarely united, and is to a certain extent incongruous, I might even say antagonistic. The mind of the physiologist is not the mind of the physicist, and there is occasionally a little heating from friction between the two." And yet the boundary-line between these two sciences ought to be remarkably fruitful in discoveries!

In proof of public ignorance of the physiological bearings of electricity, Dr. Stone quotes from a recent pamphlet the remarkable utterance that "man is himself a magnet; that his blood and every tissue of his body is pervaded by magnetic influence; that he may be acted upon magnetically by magnets; that in some persons the magnetism disengaged by the contraction of the muscles is sufficient to deflect the needle of the compass, &c."

Another recent author asserts that the resistance of the body varies within wide limits—300 to 100,000 ohms! He adds:—"Suffice it to say that the rheostats are conveniently made of telegraph-wire, well insulated in india-rubber, and the electrodes called so because the human body behaves like an electrolyte in the circuit."

After these specimens of Science for the million, our author expounds the methods in which electric action may prove fatal. There are, firstly, very high tension currents—such as lightning—which kill instantly, as if by concussion of the brain.

In another class of cases there is electrolytic action,—actual decomposition of the animal taking place, of course, at one of the poles. An instance of this kind has come under Dr. Stone's observation.

The third case is thrombosis,—coagulation in the heart, the lungs, or the larger arteries or veins. Here death is not instantaneous. Of this kind was the death at Birmingham where a musician in an orchestra seized hold of two terminals, and

died in about three-quarters of an hour. Similar was the case at Paris, which, though it occurred a couple of years ago, has only been recently reported on.

In explanation of the widely discrepant statements as to the resistance of the human body, Dr. Stone points to the highly insulating character of the human skin when dry, and the consequent difficulty of insuring contact. Some of the methods used, if applied to animals, would be branded and punished as "vivisection." But into the *corpus vile* of man it is legitimate to make holes for the purpose of securing contact.

The resistance of human subjects varies. In a diabetic patient the resistance from foot to foot was 1210 ohms; in a healthy, athletic young man, 930. In paralysis of one side, the resistance on the affected side of the system is generally about 300 ohms less than on the healthy side.

Another interesting fact is that the resistance is decidedly modified by the absorption of metals which takes place in certain trades. In a coppersmith the author found a difference of nearly 300 ohms between the hand with which he held the hammer—which was impregnated with copper—and the other hand. Mercury lessens the resistance very distinctly.

Contrary to what is often asserted, the nerves are remarkably bad conductors; muscles are much better; and water, serous fluids, and saline solutions better still. Thus when dropsy ensues the resistance goes down to one-half.

Dr. Stone does not accept the statements made of the influence of magnets on the animal body. "He had tried the experiment on a large scale, and it was now being repeated by a Society in his laboratory [the Society for Psychical Research?], but excepting the imagined sight of flames by some hysterical girls nobody had been able to point to any effect whatever produced by magnets."

Longman's Magazine. No. 24, October, 1884. London: Longmans and Co.

THERE is little, very little, in this issue which can at all come within our notice.

"Norway once More," by J. A. Froude, is a curious production. He finds "bilberries as large as grapes!" But literary characters, historians, and politicians are not trained observers, and we must allow them some latitude.

"Abjectness" is a curious subject to write about in an age one of whose characteristics is gratuitous insolence.

"Sea-Sand Grass as a Land-Winner," by F. A. Paley, is a

capital study of one of those humble agencies by which Nature effects wonderful results. That a coarse insignificant grass should bind together thousands of tons of shifting sands, so that they can neither drift back into the sea nor spread inland over the cultivated country, is a fact almost as curious as that earth-worms should manufacture arable soils and bury erratic boulders.

The Medium and Daybreak. A Weekly Journal devoted to the History, Phenomena, Philosophy, and Teachings of Spiritualism.

This paper has been sent us with a mark to an account of Miss Dale Owen's visit to Scotland, and especially to New Lanark, the scene of her grandfather's activity. The dictum of Robert Owen, "Man the creature of circumstances," is quoted. But we fear—or rather we know—that both this social reformer and his opponents overlooked the great truth that the preponderating circumstances are pre-natal; or, as it has been ably expressed elsewhere, "Nature counts for more than does nurture."

We regret to find a letter consisting of an outbreak of party politics, not originally addressed to the Editor of the "Medium and Daybreak," but copied, it would seem, from an Edinburgh contemporary. Surely the position of the philosopher, like that of the true poet, should be high, very high,—"above the battlements of party."

A writer who signs himself M., and who is said to be of the Hebrew nationality, thinks that "none should ever attempt to philosophise henceforth outside the dominions of pure physics, and social and political questions, without becoming convinced of the truth or otherwise of Spiritualism."

Light. A Journal of Psychical, Occult, and Mystical Research. Vol. IV., No. 197.

In this issue we find some matter which may fairly claim attention. An exceedingly able writer, "M.A. (Oxon)" discusses a memoir on "Visual Hallucinations in Hypnotism," communicated to the "Revue Philosophique" by M. Alfred Binet. Observations were made upon five hysterical girls at the Salpetrière. It was found that if the patient has one eye colour-blind, coloured

hallucinations cannot be suggested to it. One subject always saw at her *left* side a man dressed in scarlet: when this patient's *right* eye was closed, and her *left* eye—which was colour-blind—alone remained open, the man in question appeared to her grey and enfolded in clouds. A prism placed before the more normal eye of a colour-blind person doubles the hallucinatory image, and makes one of the images undergo a deviation in conformity with the laws of optics. A spyglass removes or approximates the object precisely as if it were real. But the strangest fact is that some—not all—of the hallucinations respond to Sir D. Brewster's test. It is well known that if we look at any object placed before us, and at the same time apply mechanical pressure to the eye-ball, the object appears doubled. This method has been proposed as a means of discovering whether anything seen has an objective reality; but according to M. Binet's results it appears untrustworthy. "M.A. (Oxon)" suggests that the patients should be got to look at their hallucinatory images through a double-refracting medium, and raises the question—Is thought a substance?

The same writer gives some interesting specimens of the alleged prophecies of the "Seer of Brahan," Coinneach Ore, who flourished about the time of the Great Rebellion. Several of these prophecies are described as having been fulfilled long afterwards, in the minutest details. The difficulty lies, of course, in ascertaining whether these prophecies were really uttered as alleged, or whether they have not been made to fit the events.

The National Reformer, Radical Advocate, and Freethought Journal. Vol. XLIV., No. 16.

THERE is very little in this paper upon which we have the right or the competence to sit in judgment, and either approve or disapprove. We note, however, the record of a fact, curious, but by no means unexampled. One Mr. Holmes writes that in his boyhood he witnessed a successful instance of the "Scare Cure":

"A gentleman who had suffered for months from rheumatism in an aggravated form, and who was evidently unable to use his limbs, was one day placed in a reclining chair, supported by blankets and pillows, and was wheeled through two or three large rooms to one in which a large open fire was burning. Over this fire a kettle with two or three pails of water had been placed for heating. Suddenly the kettle was upset, and the water pouring into the active fire caused a cloud of steam and ashes to fill the room. Our invalid leaped from his chair, and made good time to his bed-room. In about ten minutes he arose and dressed,

declaring that he felt no pain, and in a few days he was about his regular business. I knew him intimately for ten years later, and he continued strong and healthy, a firm believer in the *scare* cure." It may well be asked if this case is not as good as any of those recorded concerning the "faith cure"?

Annual Report of the Board of Regents of the Smithsonian Institution. Showing the Operations, Expenditures, and Condition of the Institution for the Year 1882. Washington: Government Printing Office.

It is satisfactory to learn that the premises set apart for the National Museum, capacious as they are, are being overtaken by the growing collections, and that further accommodation will be imperatively required. Several tons of specimens accumulated by the United States' Geological Survey are as yet but partially available, for want of space.

Among the explorations now being carried on more or less exclusively under the auspices of the Smithsonian Institution may be mentioned those in Greenland, Labrador, the Arctic Ocean, Alaska, St. Michael's, Florida, &c.

The Reports on Progress in different Sciences have, of course, the disadvantage of coming down no later than the year 1882. Besides this, some of them consist chiefly of references to journals, transactions, or to special independent works.

Meteorology and Anthropology appear to be the most favoured subjects.

Under Anthropometry we notice Zoja's scheme for a more precise classification of human stature. Here, under the not inappropriate head, "Vulgar Terms," we find the tallest and the shortest men described as of "phenomenal" stature. We regret to find this most unphilosophic term creeping more and more into use among men who certainly should know better, and in cases where "abnormal" or "enormal" would be a more correct expression.

The Mason College Magazine. Vol. II., Nos. 3 and 4.

This magazine has, like many of its contemporaries, instituted a "London letter," the writer of which, Mr. W. Greatheed, says some things which well deserved saying. He "can't go to press

without saying a word on the British Museum." But he has nothing to say concerning that momentous change which has made the Museum practically inaccessible to many of its former students.

At a meeting of the Mason College Union the question of cremation was brought forward, and a motion in its favour was carried by a majority of thirty-two to ten. The arguments against cremation were not remarkable for either novelty or cogency. One speaker seemed to lay weight on the circumstance that a Parliamentary majority of nearly two to one had recently declared itself against cremation,—as if Parliaments were localities favourable to any movement in the right direction! Professor Sonnenschein suggested burial in light wicker baskets, probably forgetting that the waste of land in the outskirts of our cities would thus be perpetuated, and that, though decay would be accelerated, disease-microbia would find every opportunity for free dissemination.

"Student-Life in Paris" is an able article, in which the black spot of French higher education—the dominating bureaucratic influence—is strangely overlooked.

In a debate on the proposition that "Where ignorance is bliss 'tis folly to be wise," Miss Cohen contended that "sorrow is a moral force, and should be utilised, not shunned." Considering that sorrow is physically debilitating, and that it interferes with the cultivation of the intellect, it should be considered whether some of the teachings of the present century are anything more than attempts to bring their author's previous opinions into apparent harmony with the principles of Evolution.

Papers on the Pollution of the Clyde at Glasgow, with Plans for the Collection and Treatment of the Sewage by Precipitation. By G. W. Muir. Glasgow: W. Porteous and Co.

The near approach of the cholera, and the possibility that in the next season it may do something more than approach, have revived the fading interest in sanitary reform. Some sense and probably more nonsense have been talked on the subject; the impracticable notions of the late Royal Rivers' Pollution Commission have been once more raked out of the dust-bin of the past, where it seems not to have become entirely purged from that lack of truthfulness by which it was characterised a dozen years ago.

Among other communities the good city of Glasgow became conscious that it, too, has a very unsavoury—though once

beautiful—river, and that, unlike London, it does not possess the right to go on polluting.

The compilation before us contains little with which students of the sewage question are not already familiar. But old truths have to be again and again repeated, especially when they are almost drowned by old errors. We can therefore recommend this pamphlet to all friends of sanitary reform.

The American Exhibition, London, 1886. *Public Opinion in Great Britain and the United States.* London: Waterlow and Sons, Limited.

The American Exhibition of the Arts, Manufactures, Products, and Resources of the United States of America, London, 1886. London: Waterlow and Sons.

As the subject-matter of these pamphlets is discussed by our esteemed contributor "An Old Technologist," they will require no further notice on our part.

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

HYLOZOISM AND HYLO-IDEALISM.

As a further contribution to my argument, in the October issue of the "Journal of Science," that each individual sentient creature frames its own universe, or, as the great Naturalist Oken puts it in his Pythagorean fragment, that the Universe is only a continuation of our sense organs (Sinnen system)*, let me be permitted to quote the following numbered Notes. They are extracts from the "Conclusion" of an otherwise vulgarly realistic treatise, "Water and its Teachings in Chemistry, Physics, and Physiography," by C. Lloyd Morgan, F.G.S., and seem thoroughly to vindicate and sanction, even as the result of Physical Research quite innocent of Biology, that hylo-phenomenal system of the world and of Life and Mind I have been presenting to the notice of my contemporaries for very many years past. This somatic theory seems quite to march with the Pre-Socratic Protagorean Hylism that each man is to himself the measure and standard of all existing things or nothings whatsoever—a thesis which, by negativing all knowledge outside the Self, in a world where all is seeming, seems quite to dispose of, and depose the immaterial or supernatural (animistic) chimera at the root of all Theology and Divine Worship (Religion). The whole spiritual domain is clearly thus, at one fell swoop, for good and all, for ever and a day, eradicated by identification of thought and its objects (processes)—"things," on this hylo-phenomenal assumption, being resolved, or dissolved, into thoughts, *i.e.* cerebral processes. I intercalate among Mr. Morgan's notes a few comments of my own.

Note 1712.—Water is coloured. Now, one of the conditions of this colour is that there should be an eye to see it. [This condition is the very essence of sight which an object seen really is].† Physically speaking, the water is not coloured.

Note 1713.—The water may be warm, but this warmth must be *felt* [or, in other words, heat is ultimately a mode of feeling, not merely a mode of motion, as Dr. Tyndall, sticking half way, as vulgar realism must, has described it]. Physically speaking,

* I need hardly point out to the readers of the "Journal of Science" that the German word *Sinn* means mind as well as sense. *Sinnen welt* is the usual term for external world, the term "external" being thus clearly a misnomer, all sense and thought being self-evidently subjective or "internal."

† Elsewhere the eye has been termed "the only colour box," a synonym or parallellism for the sole manufactory of light.

it is merely in vibration, and this vibration must be communicated to our nerves [*i.e.* be subjectived or assessed] before it is felt [cognized] as warmth.

Note 1714.—All our knowledge of water [and of every "thing" else] is derived through our senses of sight, touch, hearing, smelling, and taste [and which senses sensate only sensations; they cannot sensate "things" *per se.*]

Note 1715. When water in any way *affects* these senses it gives rise to states of consciousness, which are not material like the water [which we can thus only "know" as a "state of consciousness."] Water, and *pari passu*, all other *pseudo* objects or *tout ensemble* of such are therefore only mental (cerebral) *affections*, or symbols, the German equivalent for which latter term is *Sinn bild* (sense image).

Note 1716.—These immaterial [ideal or phenomenal] states of consciousness are symbols for that material we call water [and the converse is equally true that water is a symbol or sense image conjured up by the magic of our own sensorium.]

Note 1717.—All our knowledge, then, is a knowledge of those symbols. [Surely all *Gnosis* of any kind must be subjective or egoistic.] But since these symbols are the same [an ambiguous term; they can only be similar, *not identical*, in any two heads] for you and me, we can refer them to an outside entity we call [or visualize, or represent to ourselves] as the water. [The *sense* of "outness," just because it is a sense, or sensation, or idea, *must*, therefore, be a strictly inner function.]

Note 1718.—One of the conditions of all that we know about water [the essence rather of all our *Gnosis* altogether, abstract or concrete], is that there should be someone constituted like ourself to experience the states of consciousness, [which states are all the *Gnosis* to which we have access of all things visible or invisible within or without us].

Note 1719.—In other words, all that has been said in these notes applies to water as it appears to you and me [*i.e.* as a hylo-phenomenon]. And thus ends Mr. Morgan's treatise. Of course it is self-evident that any other *pseudo* object or sum total of them answers to the above stipulations as well as water. Indeed, Mr. Morgan elsewhere, in the body of his work, while treating his theme quite in the spirit of vulgar realism, defines a so-called "Law of Nature," universal gravitation being specially indicated (see Note 744, &c.), as simply "a generalised statement of facts as we know them," *i.e.*, as an abstract mental process or idea. This definition is amply confirmatory of Hylo-Idealism (Mentalism), *i.e.*, the unification of subject and object, thus degrading the latter to the parasitic rank of *pseudo* object. We thus practically deify Humanity, and indeed all other living creatures endowed with consciousness, as creators of their own world.

ROBERT LEWINS, M.D.

October 8, 1884.

NOTES.

A NEW Camera Lucida has been invented by Dr. Schröder, possessing many advantages over the well-known contrivance of Dr. Wollaston. The pencil emerging from the eye-piece of the microscope is reflected twice, as in the old instrument, but the view of the paper and pencil is obtained by means of another prism placed under the first; the pencil from the microscope is totally reflected, and cannot pass through the film of air between the prisms, and the paper is seen directly through the two prisms, which offer no more obstruction to the view than a thick piece of plate glass. The position of the image does not shift when the eye is moved, and the painful strain caused by the bisection of the pupil in the Wollaston instrument is entirely avoided. Drawings can be taken either with the body of the microscope at the usual inclination of 45°, or in a vertical position, both more comfortable in every respect than the old horizontal one, and preventing disturbance of the illuminating arrangement by having to shift everything when a drawing is required.

M. Miquel (Semaine Médicale) has examined the number of bacteria in portions of air of 10 cubic metres each, taken in quick succession. At heights of 2000 to 4000 metres in the Alps the number was 0; on lake Thun (560 metres above sea-level), 8; near the Hotel Bellerne (500 metres), 21; in a room in the Hotel, 600; in the Parc de Montsouris, 7,600; and in the Rue de Rivoli, Paris, 55,000. Cold has little effect upon bacteria. Miquel found 750,000 living bacteria in a block of ice from Lac de Joux which had been preserved for eleven months. Atmospheric microbia resisted thirty-six hours' exposure to a temperature of −100° C., and revived in three days.

Higher Education in China.—Perhaps the most efficient obstacle of all, not only to mining, but to every other form of the economic application of science, lies in the essentially anti-scientific character of Chinese education. Official employment is the sole and the universal ambition of the Chinese people, and the only avenue to it is through competitive literary examinations. This is no sham, the examinations being so severe that only a minority of the candidates pass, the plucked ones coming up year after year, even to old age. The subjects of examination are handwriting and style. The former is so much prized by the Chinese, that busy men practise it all their

lives, and mottoes and texts written by eminent hands are eagerly sought after. A good literary degree in China implies a marvellous amount of study of the Chinese classics, which, to secure the highest excellence, have virtually to be committed to memory. The competitive essays on given themes are judged, not by their substance, but by their style, that is to say, by the writer's ingenuity in filling his paper with laconic but recondite classical allusions which would be unintelligible to a reader not conversant with the whole range of Chinese literature. This system makes such exhaustive demands, not only on all the best years but all the half-hours of life, as to leave absolutely no room for natural science, even if the taste for it existed. It follows, as a natural consequence, that a Chinese literate is more ignorant than a European child of everything in earth, air, and sea.—"Mining World."

[May we English not almost say to ourselves, "*Mutato nomine de te Fabula narratur.*"

At the Blois meeting of the French Association for the Advancement of Science Dr. Voisin described his successful experience in the hypnotic treatment of lunatics and sluggards. If he could hypnotise certain mischievously-active persons, and reduce them to a state of harmless idleness, he would deserve thanks.

We read that "the electric light is a great boon to fruit growers near the cities in California. At Los Angelos, it is reported, several bushels of moths are killed every night, while at Sacramento it is believed that the black beetle has been nearly exterminated." But what if species useful in the fecundation of plants are killed off also?

The quantity of solid excrementitious and refuse matters at Paris is 2,500 cubic metres daily. The volume of the sewage is 300,000 cubic metres per twenty-four hours.

Dr. Ogston, of Aberdeen, describes, in the "British Medical Journal," a decided and fatal case of scarlet fever in a canary.

We share the regret expressed by our medical contemporaries at the hesitation—to use the mildest term—shown by Mr. Mundella in suppressing the ruinous system of overwork in elementary schools.

The walnut tree may be most advantageously felled for timber at the age of 250 to 300 years; the Spanish chestnut at 200; the lime-tree at 125; the beech at 95; the fir at 90; the white willow at 40; and the alder, the birch, and the poplar at 50 to 60 years.

An abnormal specimen of a species of the genus Homalomya, having seven legs, was exhibited by Mr. Billups at the October meeting of the Entomological Society.

The connection between the hay Bacilli and those of anthrax (*Bacillus subtilis* and *B. anthracis*) is the subject of controversy. Buchner maintains their identity, which Koch denies. Prazmowski pronounces them specifically distinct; but he agrees with Buchner and Pasteur that a non-pathogenous race may be obtained from *B. anthracis*, though retaining all its original morphological characters.

S. G. Potter, D.D., winds up an attack on Spiritualism with a very neat advertisement of Carpenter's "Mental Physiology."

The French Association for the Advancement of Science is so largely technological that it might fitly take the title of an "Association for the Advancement of Industrial Art."

It appears ("Ciel et Terre") that in France fragments of a tree which has been struck by lightning are eagerly collected and carefully preserved by the country people as a cure for toothache.

According to M. Kremser, who has recently studied the rainfall of Italy, Germany, and England, we have had in this country, from 1845 to 1880, nineteen years too dry and seventeen too wet.

"Cosmos les Mondes" concludes that in the experiments of Mr. Capper, as in those of Mr. "Stuart Cumberland," there is nothing marvellous beyond excessive sensibility combined with great skill in observation.

Certain astronomers ("Ciel et Terre"), especially Von Lindenau, and more recently Dr. J. Hilfiker, of Neuchatel, maintain that there is a periodic variation in the apparent diameter of the sun. Dr. Hilfiker holds that this periodicity coincides with that of the sun-spots. The maximum diameter coincides with the sun-spot minimum, and *vice versâ*.

M. Alphonse de Candolle has discussed, before the Natural History Society of Geneva, the question whether the colour of the human eye is hereditary. He maintains that dark eyes tend to become more numerous. Most frequently the colour of the mother's eyes determines that of the childrens', and especially of the sons'.

At the Blois meeting of the French Association M. E. Cartailhac proved that the operation of trepanning was known and practised in prehistoric ages.

Otto Krimmel ("Meteorol. Zeitschrift") states that at Kiel, on the evening of July 2nd last, drops of rain fell so large as to make spots on the flags of 6 to 8 centimetres (2⅓ to 3 inches) in diameter.

The "Graphic" thinks that for one person who feels any interest in the proceedings of the British Association a hundred will carefully read over the reports of the late "Church Congress." This is an unadvised utterance. The proceedings of the British Association will be carefully summarised and criticised in Germany, Italy, Belgium, France, &c., when no one outside of strictly clerical circles will even think of the Church Congress.

According to Mr. J. B. Haycraft ("Proc. Royal Soc.") leeches, in biting, inject into the blood a liquid which destroys the natural coagulative power of the blood.

Prof. E. D. Cope read an exceedingly interesting memoir on Catagenesis before the Biological Section of the American Association.

"Science" protests emphatically against the manner in which the law allowing American colleges the right to import foreign scientific periodicals duty free is nullified by the Customs officials.

The crayfish (*Astacus fluviatilis*) is becoming scarce in France, owing to an epidemic occasioned by a parasitic fungus, *Mycosis astacina*.

Mr. W. Brewster ("Proceedings of the Boston Natural History Society") mentions the curious fact that the kittiwake drinks salt water readily, but cannot be induced to taste fresh water.

At a late conference of homœopathists the President stated that his fraternity "raise no objection to the germ theory," but assert "that it affords no help whatever in the cure of disease!"

In the "American Naturalist" we find the following exaggerated dictum:—"Mr. Romanes, like most of his countrymen, is a devout and blind follower of Darwin, and, like most disciples, carries out his special theory of Natural Selection with more of dogmatism and unwavering trust than his master."

According to French contemporaries the phrenologists, physiognomists, and graphiologists are confronted by a new body of rivals, the pilographists, who profess to judge a man's character by his beard.

The necessity for eliminating the "Economical Section" of the British Association was never so fully manifested as at the late Montreal meeting.

The Section of "Mechanical Science," too, was guilty of something very like a trespass into political regions. Such

escapades, though committed by men of eminence, cannot be too profoundly regretted or too emphatically denounced.

French writers express dissatisfaction with the Presidential Address of Professor Lord Rayleigh, as not doing justice to French physicists.

The proposed International Association for the Advancement of Science has our most earnest good wishes, provided only it will eschew politics, which would there be more fatal than in a national association.

M. Vial, writing in "Les Mondes," seems desirous of conjuring up the old ghost "caloric," which we hoped had been laid for ever.

M. Bouquet de la Grye connects the inroads of the sea in the thirteenth century with the elevated temperature then prevailing, which permitted the cultivation of the vine in England. He suggests that the ice in the polar regions melted and increased the volume of the ocean.

Dr. Hans Molisch has demonstrated that the roots of plants may be deflected from their normal direction by exposure on one side to certain gases. If such gases are in moderate quantities the roots bend away from their source (negative ærotropism); if in larger qnantities towards such source (positive ærotropism). The side of the root most exposed to the action of the gas grows more strongly than the other.

It is said that Dr. Klein, who is studying the cholera question at Calcutta, is satisfied that Dr. Koch's bacillus is not the cause of the disease, and has swallowed a number of these microbia without any evil results.

M. de Cherville ("Cosmos les Mondes") records an instance of friendship between a tame magpie and a pack of fifteen dogs.

Five bursaries have been founded at the University of St. Petersburg in honour of Charles Darwin. They are to be employed for the support of five students in the five chief branches of Natural Science.

Dr. T. More Madden points out that the evils springing from the abuse of alcoholism were never so prevalent as at present, and that they are now traceable in the diseases of youth as well as in those of mature age.

In some districts it is believed that the wood of a tree which has been struck by lightning will not burn; that truffles are generated by thunder; that the bodies of those killed by lightning do not putrefy (the very opposite opinion exists also); and that men are never struck by lightning when asleep.

We lately witnessed a curious instance of intelligence on the part of a young cat. She prefers water to milk, and has repeatedly seen it drawn from a tap for her use. On the occasion in question she sprang up and repeatedly patted the handle of the tap with her paws, looking from time to time if the water had begun to flow.

The mortality among the workmen employed in cutting the Panama Canal has fallen to twenty-five per thousand.

The staff of the British Geological Survey now consists of one director-general, three directors, three district surveyors, fourteen geologists, twenty-five assistant geologists, four naturalists and palæontologists, four fossil collectors, and three general assistants.

According to Herr Pechule, of the Copenhagen Observatory, the number of red stars in the southern hemisphere is considerable, increasing as we approach the milky way.

At the Montreal meeting of the British Association, Professor Dawkins urged the opinion that the Eskimos are survivors of the pre-historic race known as "Cave-men."

The proposed baby-show, in France, has been officially interdicted on the grounds that its character was not distinctly scientific, and that the collection of such a great number of babies might give scope for infection.

Mr. T. Mellard Reade ("Geological Magazine") contends that if the island of South Georgia had a former land-connection with South America at the distance of 1200 miles, this fact is a proof of the want of permanence of oceanic areas.

M. S. Féron ("Cosmos les Mondes") gives an instance of a hairbreadth escape from premature interment in cholera, and suggests that in this disease burial during apparent death may not be uncommon. On the faith of extensive experience in India (Pondicherry) he denies the contagious nature of cholera.

According to Mr. F. Cushing (British Association) the civilisation of the Zunis of New Mexico must have been purely indigenous. Its successive stages can be very distinctly traced.

According to the municipal engineer of Toulon, butchers and bakers were most liable to cholera, whilst the scavengers entirely escaped.

Concerning the height of the atmosphere observers differ; the lowest estimate (that of Biot) being 48 kilometres, and the highest (that of Liais and Ritter) 350 kilometres.

Dragonflies have been uncommonly numerous in various parts of the Continent during the summer. They will doubtless have cleared the air of gnats and Aphides in the winged state.

According to "Science" a lady has offered the University o Heidelberg a donation of £5000 to admit female students to th lectures. The Senate declined this handsome *trink-geld*.

According to Sir G. Birdwood the re-planting of North-western India already makes itself beneficially felt in the increasing rain-fall in the Southern Punjaub, Southern Afghanistan, Northern Beloochistan, and Northern Scinde.

A block of pumice has been picked up by a French vessel, and solemnly presented to the Academy of Sciences by M. A. Milne-Edwards on the possibility that it may have been derived from the eruption of Krakatoa!

The German Association at its last meeting showed a tendency to indulge in foreign politics.

M. H. Beauregard has had an opportunity of studying the first larval form of *Epicauta verticalis*.

Mr. JAMES STARTIN, M.R.C.S.—We are exceedingly sorry that we overlooked your important exhibit showing the ill effects of goods dyed with poisonous colours. Our sympathies are entirely with you in this matter.